CLASS 1
LAND EXTERMINATOR'S
STUDY GUIDE

DRAFT 1

March, 1978

SB
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1978

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Ministry
of the
Environment

The Honourable
George R. McCague,
Minister

K.H. Sharpe,
Deputy Minister

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Weeds have long been a problem for man. They have been pulled, cut and sworn at with little or no ~~effect~~ result. In some instances biological control, mechancial control and sanitation have had a very pronounced effect on weed populations. However, in modern times man has turned to chemicals to aid in this fight. These chemicals do not replace the other methods of control but instead add another weapon in our arsenal in the war against weeds.

The purpose of this publication is to outline the control of weeds by the use of these chemicals or pesticides.

A weed is a plant out of place, growing where it is not wanted. Weeds compete with desired plants for nutrient, water and light. They can harbour insect or disease organisms. Some, like ragweed, affect the health of allergy sufferers and everyone knows about the irritations caused by poison ivy. They can impede water flow in our ditches, present a fire hazard to our industrial sites and obscure our vision on the highways^ Last, but not least, weeds may be legislated against (or may be unsightly on a manicured lawn)

Control of weeds in crop situations will not be discussed in this manual as that is adequately covered in various other sources. Instead, control of weeds on lawns, golf courses, roadsides, railway right of ways, around industrial plants and in dry roadside ditches using pesticides will be examined.

What is a pesticide? Pesticides, as the name suggests, are materials which kill pests. A pest can be an insect, rodent, weed, fungus disease, nematode, etc. Thus, pesticides is an all-inclusive term covering materials which control all of the above problems. The pesticides which control only weeds are called herbicides.

There are two pieces of legislation covering pesticide usage in Ontario. These are the Pest Control Products Act, administered by Agriculture Canada, and the Pesticides Act and Regulations, administered by the Pesticides Control Section, Ontario Ministry of the Environment.

Λ Pest Control Products Act:

The only pesticides which may be offered for sale in Canada are those which have been registered under the authority of this Act.

Each pesticide container must bear the registration number as part of its accepted label. The label must include the brand and name of the chemical, the product's chemical composition and form, the net contents, precautionary measures, and guarantee.

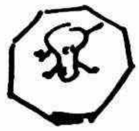
The label for each pesticide on the market must bear precautionary statements relative to toxicity. For very toxic poisons, the label includes the handling precautions, diagnostic symptoms of poisoning, and first-aid measures. It should be carefully studied before use of the product. Pesticide accidents are often due to ignoring the label warnings.

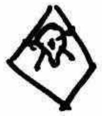
READ, AND KEEP THE LABEL INTACT AND IN GOOD CONDITION.

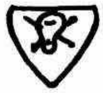
NOTE THE FOLLOWING INFORMATION ON THE LABEL:

(1) the chemical group and chemical name of the pesticide, as well as the trade name.

(2) its toxicity and hazard rating; and poison symbols, as follows:

DANGER  POISON

WARNING  POISON

CAUTION  POISON

(3) the concentration of the active ingredient in the product;

(4) the protective measures to be taken, including the correct type of respirator if required;

...../3

A2A

A LABEL IS a TOOL--LEARN TO USE IT!!

Key Points:

① TRADE NAME OF PRODUCT: Later's Sevin
② USE CATEGORY: Insecticide-Domestic
③ FORMULATION: Wettable Powder
④ SYMBOL WARNING / POISON WARNING Moderate Hazard
⑤ P.C.P. ACT REGISTRATION NO. 11.906
⑥ GUARANTEE: Carbaryl 50% (common name)
⑦ NET CONTENTS: 8oz - 227grams(metric)
⑧ MANUFACTURER'S or FORMULATOR'S NAME & ADDRESS
⑨ USE AREAS: Flowers, Trees, Shrubs, Turf, Lawns, Vegetables
⑩ PRECAUTIONS
⑪ FIRST AID - TOXICITY - POISONING SYMPTOMS - ANTIDOTE
⑫ DIRECTIONS for USE
⑬ USE LIMITATIONS: Days to Harvest

THE ENVIRONMENT
DEC 1 1977
PESTICIDES CONTROL SECTION

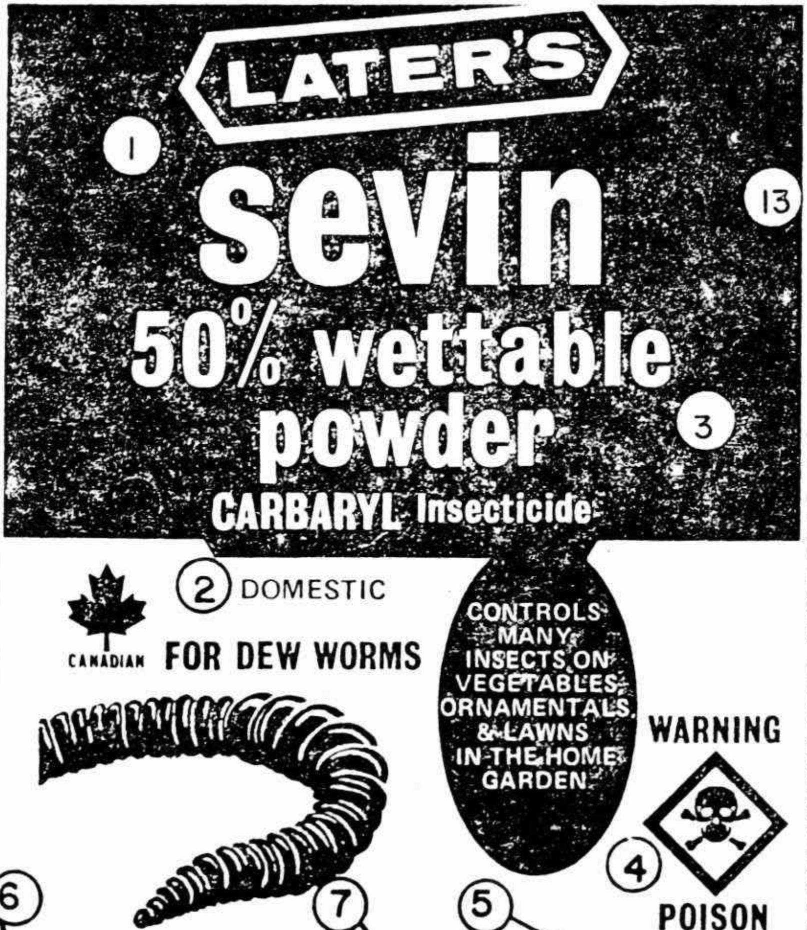
⑨ FLOWERS, TREES, SHRUBS:
Spray in early morning or evening. For scale insects, apply when crawlers are present. Do not apply on Boston Ivy or Virginia Creeper. Injury may occur if applied when leaves are tender or wet.
To control — Bagworm, Birch leafminer, Cankerworm, Black vine weevil, Blister beetle, Boxelder bug, Elm leaf aphid, Elm leaf beetle, Flea beetle, Japanese beetle, Lace bugs, Leafhoppers, Leaf rollers, Mealy bugs, Pine sawfly, Plant bugs, Psyllids, Rose aphid, Rose chafer, Rose slug, Scale insects, Tent caterpillars, Thrips (exposed), Willow leaf beetle, mix 2-3 tbsps. per gallon of water and apply for full coverage.

⑨ TURF, LAWNS:
To control Ants, Chinch bugs, Climbing cutworms, Earwigs, Fall armyworm, Fleas, Leafhoppers, Millipedes, Sod webworm — use 6 to 8 oz. in 30 - 40 gallons of water to treat 1000 sq. ft. Mow the lawn before spraying. Do not water for 2 days after treatment. Repeat in 2-3 weeks if necessary. To control earthworms, use 4 oz. in 10 gals. of water to cover 1000 sq. ft. Apply uniformly over the surface area and then water turf thoroughly.

⑩ Precautions: KEEP OUT OF REACH OF CHILDREN and animals. Do not breathe dust or spray mist. Avoid skin contact. Wash hands before eating, smoking and drinking. Avoid contamination of feed and foodstuffs. Do not contaminate streams, ponds, and water supplies. Highly toxic to bees. Do not use where bees are foraging. Warn beekeepers to protect bees from treated area for one week after treatment. Dispose of empty containers with household garbage.

⑪ FIRST AID: If swallowed induce vomiting by giving warm water containing a tablespoon of salt. If inhaled, move patient to hospital.
TOXICOLOGICAL INFORMATION: Sevin is a moderate reversible chlorinesterase inhibitor. Symptoms of poisoning — headache, nausea, vomiting, blurring of vision. Large dose of atropine may be needed to control the symptoms.

Seller's guarantee shall be limited to the terms set out on the label and subject thereto the buyer assumes any risk to persons or property arising from the use or handling of this product and accepts the product on that condition.



⑥ ⑦ ⑤

READ THE LABEL BEFORE USING REG. NO 11,906
GUARANTEE: Carbaryl 50% PCP ACT
Net Contents: 8 oz. (227 grams)

⑫ Directions for Use: Mix the mentioned amount of Sevin 50% WP to one gallon of water to cover 450 sq. ft., unless otherwise specified. Apply full coverage when insects or damage appears. The recommended amount is in level tablespoons. Repeat treatment at 7 to 10 day intervals, as required.

⑬ LIMITATIONS: Do not apply to crops within the following preharvest intervals.
1 day — Asparagus, Tomato, Carrot, Eggplant, Pepper, Strawberry, Corn.
3 days — Celery, Head lettuce, Cabbage, Broccoli, Brussel Sprouts, Cauliflower, Kohlrabi, Cucumber, Squash, Pumpkin, Beans, Peas.
7 days — Radish, Potato, Beets (roots), Turnip (roots).
14 days — Chinese cabbage, Leaf lettuce, Parsley, Spinach, Turnip tops, Parsnips, Beet (tops).

VEGETABLES: ⑨
BEANS: To control Mexican bean beetle, use 1 tbsp., Leafhopper, Flea beetle, use 2 tbsps., Climbing cutworms, use 3-4 tbsps., Lygus bugs & Stink bugs, use 4-5 tbsps.
PEAS: To control Alfalfa looper use 4-5 tbsps.
CORN: To control Earworm, Rootworm adult, Corn borer, Fall armyworm, use 2-3 tbsps., Cereal leaf beetle, 2 tbsps.; Climbing cutworm, 5 tbsps. per 1000 ft. of row in 10-12 inch band.
POTATO, TOMATO, EGGPLANT, PEPPER: To control Colorado potato beetle, use 1 tbsp.
CUCUMBER, SQUASH, PUMPKINS: To control Cucumber beetles, Climbing cutworms, Flea beetle, Leafhoppers, Squash bugs, use 2 tbsps. Injury may occur if applied when leaves are tender or wet.
CARROT, CABBAGE, BRUSSEL SPROUTS, BROCCOLI, CAULIFLOWER, KOHLRABI, CELERY, BEETS, LETTUCE, CHINESE CABBAGE, RADISH, PARSLEY, SPINACH, TURNIPS, PARSNIPS. To control Flea beetles and Cabbage worm, Lygus bugs, Meadow spittle bugs and Stink bugs, use 2-4 tbsps. Where cabbage worm is the principal problem, use a different pesticide.
ASPARAGUS: To control Asparagus beetles on spears, use 2-5 tbsps. — and on ferns, 4-8 tbsps. Apply full coverage in post-harvest period. Do not apply more than once every 3 days.

(5) the recommended uses and rates of application;

(6) the correct handling, mixing, and loading procedures;

(7) the first-aid treatment.

If you do not have this information, do not use the pesticide.

If you do have this information, then ensure the availability of medical supervision before proceeding.

LABEL

The Pesticides Act, 1973, and Regulation, 618/74 as amended. [redacted]

A copy of this Act and Regulation is enclosed for your convenience. However, the following are Explanations of the sections which are of specific interest to persons applying herbicides to non-agricultural land.

Pesticides Act:

1. This is a list of definitions of interest

(1) In this Act,

1. "air" means open air not enclosed in a building, structure, machine, chimney, stack, flue or vehicle;

2. "Board" means the Pesticides Appeal Board;

3. "Committee" means the Pesticides Advisory Committee;

. . . .

5. "environment" means the natural environment, a building, structure, machine and vehicle, or any of them;

6. "extermination" means a land extermination, structural extermination or a water extermination;

7. "extermination business" means an activity or enterprise carried on for the purpose of causing an extermination or exterminations to be performed for fee or payment;

8. "exterminator" means a person who, by himself or by his employees, assistants or agents, performs or enters into a contract to perform an extermination;

9. "land" means surface land not enclosed in a building or structure, land covered by water and all subsoil, or any combination or part thereof;

10. "land extermination" means the destruction, prevention or control in, on or over land of a pest or pests by the use of a pesticide but does not include a structural extermination, a water extermination or the destruction, prevention or control of termites;

11. "licence" means a licence issued under this Act and the regulations;

15. "natural environment' means the air, land and water or any combination or part thereof, of the Province of Ontario;

16. "operator; means a person who has the control and management of an extermination business, and "operate" has a corresponding meaning;

17. "permittee" means a person who is the holder of a permit under this Act;

18. "person" includes a municipality, a coporation on behalf of Her Majesty in right of Ontario, and an agent of any of them;

19. "person responsible", when used with reference to a pesticide, substance or thing, means,
    (i) the owner,
    (ii) the person having the charge, management or control of the handling, storage, use, disposal, transportation or display, or
    (iii) the person having the charge, management or control,

of the pesticide, substance or thing;

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20. "pest" means any injurious, noxious or troublesome plant or animal life other than man or plant or animal life on or in man and includes any injurious, noxious or troublesome organic function of a plant or animal;

21. "pesticide" means any organism, substance or thing that is manufactured, represented sold or used as a means of directly or indirectly controlling, preventing, destroying, mitigating, attracting or repelling any pest or of altering the growth, development or characterists of any plant life that is not a pest and includes any organism, substance or thing registered under the Pest Control Products Act (Canada);

26. "water" means surface water and ground water, or either of them;

3. No one shall deposit, or cause the deposit of a pesticide into the environment that;

(a) causes, or is likely to cause, impairment of the quality of the environment greater than would necessarily result from proper use of the pesticide;

(b) causes, or is likely to cause, property damage or injury to plant or animal life greater "than would necessarily result from proper use of the pesticide", ~~etc.~~;

(c) causes, or is likely to cause, harm or material discomfort greater, ~~etc~~.;than would necessarily result from the proper application of the pesticide

(d) causes, or is likely to adversely affect, the health of any person to a greater degree, etc.;

(e) impairs, or is likely to impair, the safety of any person to a greater degree than; etc

(f) causes, or is likely to result in, any plant or animal being unfit for use by man greater than the unfitness that would, etc.;

4. (1) No one shall offer to or perform an extermination except under the authority of the proper licence or unless exempt under the regulations.

(2) No one shall operate an extermination business except in accordance with the proper class of operator's licence or unless exempt.

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(4) Nobody shall assist, for more than seven days, a person licensed to perform land exterminations unless the holder of the licence notified the Pesticides Control Section in writing or the person is exempt.

(5) No one shall sell a pesticide unless the pesticide has been placed in one of the schedules and the vendor has the appropriate vendor's licence or is exempt under the regulations;

(7) For the purpose of this Act and Regulation every person is responsible for the acts or ommissions of his employees within the scope of their actual or apparent authority.

10.(2) The Director may refuse to issue a licence or may suspend or revoke a licence where in the opinion of the "Director"

(a) the applicant or licensee is in contravention of the Act or the regulations;

(c) the applicant or licensee or, where the applicant or licencee is a corporation, its officers or directors, is or are not competent to carry on the activity that would be or is authorized by the licence;

(d) the past conduct of the applicant or licensee or, where the applicant or licensee is a corporation, of any of its officers or directors, affords reasonable grounds for belief that the activity that would be or is authorized by the licence will not be carried on with honesty and integrity;

(e) the applicant or licensee does not possess or will not have available all premises, facilities and equipment necessary to carry on the activity authorized by the licence in accordance with this Act, the regulations and the licence;

(f) the applicant or licensee is not in a position to observe or carry out the provisions of this Act, the regulations and the licence;

(h) the licensee has fraudulently misrepresented his services in performing an extermination or in carrying on an extermination business.

3. The Director may refuse to issue or may cancel a permit, may impose conditions in issuing or after issuing a permit where the Director is of the opinion that;

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(a) permittee is not competent to perform the extermination for which the permit is required;

(b) the permittee does not possess or will not have available all facilities and equipment necessary to perform the extermination in accordance with this Act, the regulations and the permit;

(d) there is or is likely to be harm or material discomfort or danger to health to any person;

(e) there is or is likely to be impairment of the quality of the environment;

(f) there is or is likely to be injury or damage to any property or to plant or animal life;

(h) a different method of control of extermination will or will likely be substantially as effective as the proposed extermination for which a permit is required will cause less impairment of the environment or less harm on any plant or animal life, man or property; or

(i) the use of the pesticide will not be or will not likely be effective or necessary to carry out the extermination.

11. All licences expire on the 15th day of February.

13. Where the Director proposes:

(a) to refuse to issue a licence;

(b) to suspend or revoke a licence;

(c) to make or amend a control order.

He shall inform the person to whom the order is directed of his proposal along with written reasons.

(2) The Director shall also inform this person that he is entitled to a hearing by the Pesticides Appeal Board if he provides a written notice to the Director and the Board within fifteen (15) days of receiving the notice from the Director.

(3) Where this person does not request an appeal within the stated time limit the Director may proceed with his proposal.

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4. The Appeal Board may order the Director to rescind his proposal, carry it out or alter it as the Board sees fit within the scope of the Act and Regulations.

8. Where the Director refuses to issue, alters or cancels a permit he shall provide the permittee with written reasons for his decision.

11. The above decision may be appealed by requesting a hearing by the Pesticides Appeal Board. This request must be delivered to the Director and the Board within fifteen (15) days of the decision.

15. Any party to proceedings before the Board may appeal its decision on a question of law to the Supreme Court in accordance with the rules of court.

(4) Any party to proceedings before the Board may within thirty (30) days of the decision of the Board or the court, appeal in writing to the Minister on any matter other than a question of law. The Minister may alter the decision of the Board in a manner which he considers to be in the public interest.

17. (1) The Minister may designate provincial officers for the purposes of this Act and the Regulations.

(2) For the purpose of the administration of this Act and the Regulations, a provincial officer may, from time to time and upon production of his designation, enter at any reasonable time any building, vehicle, land or water and make investigations, tests and inquiries, examination of books, records and documents, as he considers necessary, and may remove samples, copies or extracts. [redacted]

(5) No person who is responsible for a pesticide or for a substance or thing containing a pesticide or who assists such a person shall hinder or obstruct a provincial officer in the lawful performance of his duties or furnish a provincial officer with false information.

20. (1) Where a provincial officer is of the opinion, upon reasonable and probably grounds, that an emergency exits by reason of,

(a) danger to the health or safety of any person;

(b) impairment or immediate risk of impairment of the quality of the environment;

(c) injury or damage or immediate risk of injury to any plant or animal life; or

(d) the rendering or the immediate risk of rendering, any property or plant or animal life unfit for use by man,

as the result of handling, storage, use, disposal, transportation or display of a pesticide, the provincial officer may make an oral or written stop order directed to the person responsible for the pesticide ordering such person to stop immediately either permanently or for a specific period of time.

(2) A person who is affected by a stop order made by a provincial officer may appeal by telephone or otherwise to the Director and the Director, after receiving the submissions of the person and of the provincial officer, shall vary, rescind or confirm the stop order.

(3) Where the Director makes a stop order or varies or confirms a stop order the Director shall send a written copy of the stop order together with written reasons ~~therefor~~, ~~upon~~ to the person to whom the stop order is directed.

(4) A stop order, or a stop order submitted by the Director shall inform the person to whom it is directed that he is entitled to a hearing by the Board if he delivers to the Director and the Board, within fifteen days after a copy of the stop order is served on him, notice in writing requiring a hearing.

(5) Notwithstanding that an appeal is taken against a stop order, the stop order is effective ~~[illegible]~~ from the time it is communicated to the person to whom it is directed until confirmed, varied or rescinded on appeal and such person shall comply with the stop order immediately.

21. (1) Where the handling, storage, use, disposal, transportation or display of a pesticide,

(a) causes or is likely to cause impairment of the quality of the environment;
(b) causes or is likely to cause injury or damage to property or to plant or animal life;
(c) causes or is likely to cause harm or material discomfort to any person;
(d) adversely affects or likely to affect adversely the health of any person;
(e) impairs or is likely to impair the safety of any person;
(f) renders or is likely to render any property or plant or animal life unfit for use by man,

the Director may make a control order directed to the person responsible for the pesticide.

(2) The Director may order the person to whom the order is directed to,

(a) limit or control the rate of deposit of a pesticide into the environment in accordance with the directions set out in the order;
(b) stop the deposit
  (i) permanently,
  (ii) for a specified period of time, or
  (iii) in the circumstances set out in the order; and

(c) comply with any directions set out in the order relating to the manner in which a pesticide may be handled, stored, used, disposed of, transported or displayed.

22. Every person who deposits a pesticide into the environment out of the normal course of events;

shall notify the Director immediately.

23. (1) Where any person deposits, causes or permits the deposit, of a pesticide that causes or is likely to cause; injury or damage

(a) to the quality of the environment;
(b) any property or water
(c) plant or animal life; or
(d) a person,

the Minister, where he is of the opinion that it is in the public interest to do so, may order the person responsible for the pesticide to take all steps within such time as may be specified in the order for the purpose of preventing or repairing such injury or damage or impairment or to restore such quality.

25. This Act binds the crown.

26. A licence or a permit under this Act is not transferable. [redacted]

32. Where the Minister or the Director has authority to order a thing be done, the Minister may order that, in default of its being done by the person ordered to do it. That it shall be done at the expense of such person, and the Minister may recover the cost of doing it, with costs, by action in a court as a debt due to the Crown. [redacted]

33. No person shall knowingly give false information to the Minister, a provincial officer or any employee of the Ministry in respect of any matter under this Act or the regulations. [redacted]

34. Every person who contravenes any provision of this Act or the regulations is guilty of an offence and on conviction is liable on a first conviction to a fine of not more than $5,000. for every day or part thereof upon which the offence occurs or continues and upon a subsequent conviction to a fine of not more than $10,000. for every day or part thereof upon which the offence occurs or continues. [redacted]

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ONTARIO REGULATION 618/74

under The Pesticides Act, 1973

GENERAL

Interpretation

1. In this Regulation,

(a) "adequate respiratory protection" means a respiratory device or devices which effectively protects the user from adverse effects which might result from breathing in of a pesticide during the handling or use of the pesticide;

(b) "adequate protective clothing" means clothing including rubber or neoprene boots, ~~rubber or neoprene~~ gloves, hats, coats and other garments that effectively protect the user from adverse effects which might result from a pesticide coming in contact with the skin during ~~or after~~ the handling or use of the pesticide;

(ab) "agricultural or forestry production" means the production of plants, animals, or both, by an agriculturalist;

(ba) "air-blast machine" means a pesticide application device utilizing an independent mechanically produced stream of air to assist the carrying of the pesticide beyond the orifice of the device;

(d) "drainage ditch" means a man-made water course, added to the natural land drainage system, primarily to collect and convey water and which, for some period each year, does not contain flowing water;

(e) "farm land" means land, or a farm structure, or both, used for agricultural or forestry production where it comprises,

- (i) at least eleven acres that are contiguous except for division by a street, road, railway or water, or
- (ii) less than eleven acres, if there has been an average gross annual revenue over the three years immediately preceding or a gross revenue in the year immediately preceding ~~the date of the sale or proposed sale at retail of a pesticide for use on the land or the farm structure~~ of not less than $2,000 from the sale of the products of agricultural or forestry production, or both, produced on the land or farm structures, or both;

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(i) "herbicide" means any pesticide used for the destruction or control of any vegetation;

(j) "hormone type herbicide" means any pesticide containing,

  (i) 2,4-D,
  (ii) 2,4-DB,
  (iii) 2,4,5-T,
  (iv) mecoprop,
  (v) fenoprop,
  (vi) MCPA,
  (vii) MCPB,
  (viii) dichlorprop,
  (ix) dicamba,
  (x) TBA
  (xi) fenac, or
  (xii) picloram;

GENERAL REQUIREMENTS FOR EXTERMINATOR'S LICENCE

6. (1) An applicant for any class of exterminator's licence shall submit with his application the names of at least two reputable persons who have known the applicant for at least one year immediately prior to the application and are prepared to attest to his good reputation. [redacted].

(2) An applicant for any class of exterminator's licence shall,

(a) be physically fit for the purpose of performing exterminations and provide a certificate to this effect from a legally qualified medical practitioner;

(d) be at least sixteen years of age.

(4) An applicant for any class of exterminator's licence to perform exterminations on his own premises or the premises of his employer is exempt from the need of names of character references. [redacted].

(5) Every applicant for an exterminator's licence and every exterminator shall notify the Director of any change in the information furnished in or with his application within ten days after the effective date of the change. [redacted].

FEES

7. (1) The fee for each class of an operator's licence, or renewal of any of them, is $15.

(2) The fee for each class of an exterminator's licence, or a renewal of any of them, is $10.

EXAMINATIONS

10. (1) The fee for an examination for each class of licence is $5.

(2) An applicant who fails to attend a scheduled examination and fails to notify the Director of his inability to attend at least forty-eight hours before the time fixed for the examination shall forfeit his examination fee and be required to pay a new examination fee.

(3) Notwithstanding subsection 2, an applicant who fails to attend a ~~shc~~scheduled examination three times within a six-month period shall forfeit his examination fee.

(4) An applicant for a licence shall be given at least seven days notice of the date, time and place fixed for his examination.

(5) No applicant shall be permitted to try an examination for a licence as an operator or for the same class of exterminator's licence more than twice in any period of twelve months. [redacted]

EXTERMINATOR'S LICENCE

11. (1) An oral examination for any class of exterminator's licence shall be given by at least two examiners.

(3) An examination of an applicant for a licence to perform any class of land or water exterminations may be a written or oral examination, or both.

(4) At least one examiner or a person designated by the examiners shall be present at a written examination.

(5) The examiners shall examine the applicant for any class of exterminator's licence on his knowledge of,

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(a) the provisions of the Act and the regulations thereunder;

(b) the toxicity and hazard, first-aid and antidotes and the forms and methods of application of the pesticide or pesticides that the prescribed class of licence for which the applicant is applying shall entitle him to use, and

(c) the identification, life history, habits, characteristics and control of pests that may be subject to extermination. [redacted]

21. (1) [redacted], No person shall use any pesticide in an extermination unless it is registered under the Pest Control Products Act (Canada) and is classified under this Regulation.

(2) No person, except an accredited researcher, shall use any pesticide,

(a) for any purpose other than that for which the pesticide is sold or represented;

(b) in any manner other than that designated on the conditions of registration; and

(c) for any purpose other than that for which the pesticide is authorized for use under this Regulation.

22. No person shall use water from a lake or other surface water in performing exterminations unless the equipment used in the extermination is equipped with an effective device to prevent back-flow. [redacted]

23. No person shall wash any equipment used to perform an extermination in any lake or other surface water or in such a manner that any pesticide may be discharged into any lake or other surface water. [redacted]

CONTAINERS

24. (1) No person, other than a wholesale vendor or a limited wholesale vendor, shall have in his possession a pesticide other than in the container in which it was originally offered for sale.

(2) This does not apply to a person,

(a) who is performing an extermination in accordance with the Act and this Regulation; or

(b) who places the pesticide into a secondary container of a type and composition that is customarily used or approved by the manufacturer of the pesticide for that pesticide and bears a label in English denoting the trade name or common name and concentration of each active ingredient in the pesticide product. [redacted]

25. (1) An empty container that has been used to hold a Schedule 1, 2 or 5 pesticide shall be disposed of by puncturing or breaking and burying the container in such a manner that it is covered by at least eighteen inches of soil and is not near any watercourse or water table.

26. Where the original container of a Schedule 1, 2 or 5 pesticide is damaged or broken, the person responsible for the pesticide shall,

(a) replace the container with a container equivalent to that originally used; or

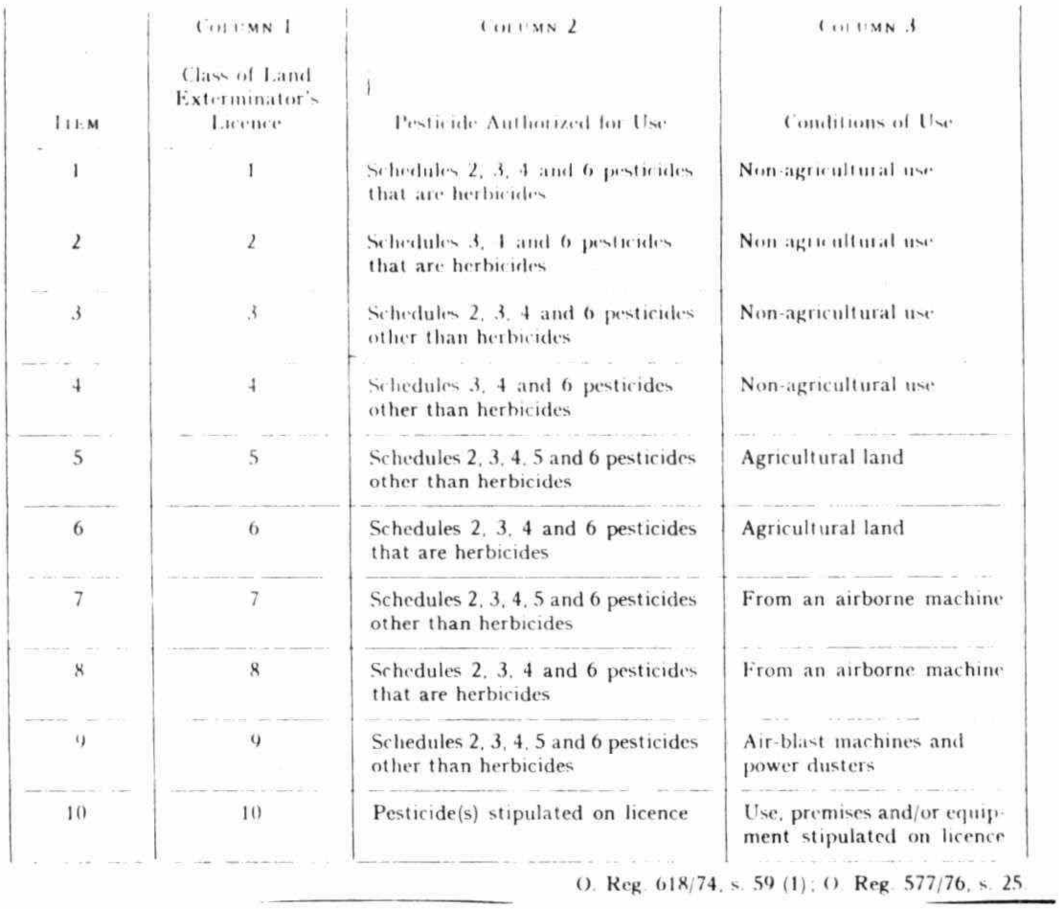
(b) dispose of the container and its contents by burying them under eighteen inches of soil in such a manner that they are not near any watercourse or water table; and

(c) clean up any spillage and decontaminate any area, carrier or commodity that has come in contact with the pesticide. [redacted]

FIRES, ACCIDENTS, THEFTS

27. (1) If a pesticide is involved in a fire or other occurence, such as theft, other than in the normal course of affairs, the person responsible for a pesticide shall notify the Director immediately.

LAND EXTERMINATOR LICENCES



TABLE

Item	Column 1 Class of Land Exterminator's Licence	Column 2 Pesticide Authorized for Use	Column 3 Conditions of Use
1	1	Schedules 2, 3, 4 and 6 pesticides that are herbicides	Non-agricultural use
2	2	Schedules 3, 4 and 6 pesticides that are herbicides	Non-agricultural use
3	3	Schedules 2, 3, 4 and 6 pesticides other than herbicides	Non-agricultural use
4	4	Schedules 3, 4 and 6 pesticides other than herbicides	Non-agricultural use
5	5	Schedules 2, 3, 4, 5 and 6 pesticides other than herbicides	Agricultural land
6	6	Schedules 2, 3, 4 and 6 pesticides that are herbicides	Agricultural land
7	7	Schedules 2, 3, 4, 5 and 6 pesticides other than herbicides	From an airborne machine
8	8	Schedules 2, 3, 4 and 6 pesticides that are herbicides	From an airborne machine
9	9	Schedules 2, 3, 4, 5 and 6 pesticides other than herbicides	Air-blast machines and power dusters
10	10	Pesticide(s) stipulated on licence	Use, premises and/or equipment stipulated on licence

O. Reg. 618/74, s. 59 (1); O. Reg. 577/76, s. 25.

61. (3) No person shall perform a land extermination by means of a pesticide containing picloram unless he is a holder of a permit for the land extermination issued by the Director. [redacted]

LAND EXTERMINATION EXEMPTIONS

70. Where a person performs a land extermination for domestic purposes on land occupied by him by means of a Schedule 3 pesticide, he is exempt from the need of an exterminator's licence. [redacted]

71. (1) Where a person performs a land extermination by means of a Schedule 4 or 6 pesticide on premises owned or occupied by him or by a person of whom he is the full-time employee, he does not need an exterminator's licence.

(2) Where a person performs a land extermination by means of a Schedule 3 pesticide on premises to which the public is not admitted and which are owned or occupied by him or by a person of whom he is the full-time employee, he does not need an exterminator's licence.

76. (1) Where an area weed inspector under The Weed Control Act, in accordance with his duties under that Act, performs a land extermination by means of a Schedule 2, 3, 4 or 6 herbicide and uses a compressed-air hand sprayer or equipment no larger than a knapsack sprayer, he does not need an exterminator's licence.

(2) A municipality which performs a land or water extermination for another municipality by means of a Schedule 2, 3, 4 or 6 pesticide is exempt from needing an operator's licence.

78. No operator shall permit a vehicle to be used in transporting or applying a pesticide to be used in connection with a land extermination performed by a person licensed to perform land exterminations as a Class 1, 2, 3, 4, 5, 6, 9 or 10 land exterminator unless a plastic identification ~~plate~~ sticker is obtained from the Director and is affixed to the rear of the vehicle in such a manner that the plate is visible and legible at all times. ~~O. Reg. 577/76, s. 39.~~

SUPERVISION OF EQUIPMENT

79. (2) An exterminator shall not supervise an extermination or exterminations for which a total of more than four pieces of pesticide application equipment are being used at any time.

(3) Whenever an extermination mentioned above is being performed and the exterminator is not present, he shall ensure that a person at least sixteen years of age carrying a certificate signed by the exterminator certifying that the person is competent to perform the extermination is present and in charge of each piece of pesticide application equipment. [redacted].

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GENERAL STORAGE

98. No person shall store any pesticide in such a manner that the pesticide is likely to come into contact with food or drink intended for human or animal consumption. ~~O. Reg. 618/74, s. 98.~~

99. Every person responsible for a Schedule 1, 2 or 5 pesticide shall ensure that,

(a) any room in which the pesticide is stored is ventilated to the outside atmosphere;

(b) a placard is affixed and maintained on the outside of each door leading into the room in which the pesticide is stored bearing the words "Chemical Storage Warning - Authorized Persons Only" in block letters clearly visible; and

(c) no person can enter the room in which the pesticide is stored without the express permission of the person responsible. ~~O. Reg. 618/74, s. 99~~

102. (1) Everybody should store pesticide,

(a) in such a manner that the pesticide will not likely contaminate food or drink intended for human or animal consumption;

(b) in such a manner that the pesticide will not be likely to impair the health or safety of any person;

(c) ~~in an area that has a warning sign prominently displayed at the entrance thereof indicating the presence of a pesticide and stating that the pesticides may be handled only by the licensee or his employees;~~

(d) in an area near which there is prominently displayed a list of emergency telephone numbers, including those of the local fire department, hospital and poison control centre; and

(e) in an area that is maintained in a clean and orderly manner. ~~O. Reg. 618/74, s. 102 (1).~~

~~(2) A person who stores any Schedule 1, 2 or 5 pesticide should store the pesticide in an area.~~

~~(a) that is well ventilated;~~

~~(b) that is not accessible to the public and which is locked when the licensee, or an employee of the licensee, is not present on the premises on which the pesticide is stored;~~

(c) in an area near which adequate respiratory protection and adequate protective clothing are kept readily available by the licensee for emergency purposes; and

(d) that has no floor drain that leads into or drains directly or indirectly into a storm sewer, sanitary sewer or watercourse. ~~O. Reg. 618/74, s. 102 (2), O. Reg. 577/76, s. 55 (1).~~

FACTS
about pesticides

Ontario
Ministry
of the
Environment

Hon. George A. Kerr, Q.C.
Minister

K. H. Sharpe
Deputy Minister

DATE: March 1977
NUMBER: 30-01-01

ONTARIO CLASSIFICATION OF PESTICIDE PRODUCTS

INTRODUCTION

Under the authority of The Pesticides Act, 1973 and Regulations administered by the Pesticides Control Section, Ministry of the Environment, all pesticide products sold in the Province of Ontario must be classified and assigned a schedule.

The pesticides classified are listed by their P.C.P. number or Registration number in their assigned Schedule at the back of The Pesticides Act 1973.

Pesticides are classified into six schedules on the basis of their toxicity, environmental or health hazard, persistance of the active ingredient, or its metabolites, concentration and usage. This classification system is aimed at controlling the distribution, availability and use of pesticides in Ontario.

The following is a brief outline of the criteria used for scheduling pesticides in Ontario and is meant as a guide for candidates preparing for Operator's and Exterminator's licences.

SCHEDULES 1 and 5

Schedule 1 pesticides are restricted and can only be used by the holder of a specific use permit.

Schedule 5 pesticides are limited to application on agricultural land.

Criteria used for defining Schedule 1 include

1) pesticides that pose a serious hazard to public health and/or natural environment.

2) pesticides exhibiting

Acute oral LD_{50} (single dose - mg/kg)	0 - 50
Acute dermal LD_{50} (single dose - mg/kg)	0 - 100

.....2.

Inhalation Limits LC$_{50}$
(continuous for 8 hours
- mg/l air) 0 - 2, i.e. methyl bromide

3) pesticides which are persistent and/or give rise to persistent metabolites that produce undesirable side effects on non-target organisms either by acute or chronic toxicity, i.e. DDT

4) pesticides which through their mode of action may inflict unnecessary suffering to pest vertebrate animals.

Criteria used for defining Schedule 5 include

1) pesticides that pose a serious hazard to public health and/or the natural environment

2) pesticides exhibiting
Acute Oral LD$_{50}$
(single dose - mg/kg) 0 - 50

Acute Dermal LD$_{50}$
(single dose - mg/kg) 0 - 100

Inhalation Limits LC$_{50}$
(continuous for 8 hours
- mg/l air) 0 - 2

3) the lack of less hazardous control products which could provide adequate protection to agricultural crops

SCHEDULE 2

Pesticides in this schedule are restricted to agriculturists, licensed exterminators and registered custom sprayers.

Criteria used for defining Schedule 2 include

1) organic pesticides that do not present problems of long term persistence or accumulation in biological tissues and those inorganic pesticides that may present a degree of hazard to the environment

2) pesticides exhibiting
Acute Oral LD$_{50}$
(single dose - mg/kg) 50 - 500

Acute Dermal LD$_{50}$
(single dose - mg/kg) 100 - 1,000

Inhalation Limits LC$_{50}$
(continuous for 8 hours
- mg/l air) 2 - 20

SCHEDULE 3

Schedule 3 pesticides are available to the homeowner. Hazards are considered minimal for the use of these pesticides.

Criteria used for defining Schedule 3 include

1) pesticides exhibiting
Acute Oral LD$_{50}$
(single dose - mg/kg) 500 - 5,000

Acute Dermal LD$_{50}$
(single dose - mg/kg) 1,000 - 10,000

Inhalation Limits LC$_{50}$
(continuous for 8 hours
- mg/l air) 20 - 200

2) pesticides should pose minimal hazards to the environment or to public health

3) organic pesticides that are short-lived and do not produce either persistent or toxic metabolites

4) those inorganic pesticides that present a minimal environmental hazard

5) product residues should not pose a problem when 'empty' containers are disposed of in municipal garbage

SCHEDULES 4 and 6

Schedule 4 products are those that can safely be handled by any type of outlet and would be available for sale in food handling establishments. They must carry a federally approved domestic label.

Schedule 6 products are identical to those in Schedule 4 but there is no limit to package size and the product may be designated for commercial use.

Criteria used for defining Schedules 4 and 6 include

1) pesticides exhibiting

Acute Oral LD$_{50}$
(single dose - mg/kg) > 5,000

Acute Dermal LD$_{50}$
(single dose - mg/kg) > 10,000

Inhalation Limits LC$_{50}$
(continuous for 8 hours
- mg/l air) > 200

2) pesticides that are of no known hazard to the environment or to domestic pets

NOTE

Test animals for toxicological data in order of preference are:

1) primates
2) dogs and cats
3) rodents
4) fish and birds

Classification is based on lowest valid LD$_{50}$ values. Other effects considered - carcinogenesis, etc.

SAFETY

Pesticides have become an essential part of modern life, but they are not without their disadvantages. All pesticides are poisons and while herbicides are perhaps the least toxic group they deserve to be handled with respect. They have been designed to kill plants but can also be harmful to man and other organisms. For this reason, pesticides must always be treated with caution, and all persons having contact with them must be well versed in pesticide safety.

It is essential the pesticide poisoning incidents be recognized for what they are immediately. First Aid, as discussed, is not a substitute for professional medical assistance, but is a means of helping the party until professional medical assistance is obtained. Know what first aid procedures to use, you may be a lifesaver.

EMERGENCY ACTION

MAJOR CRASH OR SPILL

If intoxication occurs due to direct contact with the pesticide:

STEP 1: Move the patient well away from any contaminated area and from the vicinity of pesticides. Quickly remove any contaminated clothing, Wash exposed area with soap and water.

STEP 2: Start the first-aid treatment immediately.

STEP 3: Call a physician as quickly as possible (but do not abandon the first-aid treatment).

STEP 4: Keep the patient as quiet as possible and complete the first-aid treatment. Keep the patient warm and comfortable.

STEP 5: If there is respiratory weakness, or if breathing ceases, give artificial respiration immediately.

STEP 6: If the symptoms are of a moderate or severe case of organophosphate or carbamate poisoning, and the patient is conscious, two atrophine tablets (1/100 grain each) should be administered by a medical doctor or under his supervision.

STEP 7: If medical help cannot be obtained or is delayed, transport the patient to the nearest hospital, physician's office, or poison control centre. Take the pesticide label or the

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container or any available records of pesticides used; and any other information, such as these notes. A list of poison control centres in Ontario is attached to back of this publication.

ADVISE ATTENDING PHYSICIAN IF ATROPINE HAS BEEN ADMINISTERED.
NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

If intoxication due to continued exposure to the pesticide is at any time suspected:

STEP 1: If the symptoms are more than minor irritation, call a physician immediately.
STEP 2: Keep the patient as quiet as possible.
STEP 3: If there is evidence of respiratory weakness, give artificial respiration.
STEP 4: If unconsciousness or convulsions occur, apply first-aid procedures.
STEP 5: If it is known that the symptoms are due to over-exposure to an organophosphate or carbamate pesticide, and the symptoms are severe but the patient is conscious and has adequate respiration, 2 atropine tablets (1/100 grain each) should be administered by a medical doctor or under his supervision.
STEP 6: If medical help cannot be obtained, transport the patient to the nearest hospital, physician's office, or poison control centre. Take any available records or labels of pesticides used; and any other information, such as the notes to the medical profession included in this handbook.

ADVISE ATTENDING PHYSICIAN IF ATROPINE HAS BEEN ADMINISTERED.

NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

GENERAL SYMPTOMS

In general, the symptoms which indicate that pesticides poisoning has occurred are as follows:

MILD POISONING

(Note that mild symptoms may be the beginning of a progression to severe symptoms):

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headache, fatigue, skin irritation, loss of appetite, dizziness, weakness, nervousness, nausea, perspiration, diarrhea, eye irritation, insomnia, thirst, restlessness, irritation of nose and throat, loss of weight, soreness of joints, changes of mood.

MODERATE POISONING

(Note that moderate symptoms may be the beginning of severe symptoms):
nausea, trembling, muscular incoordination, excessive saliva, blurring of vision, feeling of constriction in the throat and chest, difficulty in breathing, flushed or yellow skin, abdominal cramps, vomiting, diarrhea, mental confusion, twitching of muscles, weeping, excessive perspiration, profound weakness, rapid pulse, cough.

SEVERE POISONING

vomiting, loss of reflexes, inability to breathe, uncontrollable muscular twitching, constriction of pupils (to pin-point pupils), convulsions, unconsciousness, severe secretion from respiratory tract, fever, thirst, increased rate of breathing.

FIRST AID TREATMENT

MOVE WELL AWAY FROM ANY PESTICIDE:

1. Quickly move the patient to safe uncontaminated surroundings, and remove any contaminated clothing.

IF BREATHING IS VERY WEAK OR HAS CEASED:

1. Give artificial respiration.
2. Oxygen can be beneficial.

IF PESTICIDE HAS BEEN SWALLOWED:

Do NOT induce vomiting if the pesticide solvent is a petroleum distillate, such as fuel oil or kerosene.

1. If the patient has not vomited, induce vomiting immediately. Do this by introducing a finger into the throat, or by giving warm salt water (two tablespoons of salt in a glass of warm water).
2. Give milk or cold water freely.
3. Again induce vomiting if vomit fluid is not clear.
4. Give mouth-to-mouth artificial respiration if breathing has stopped or is labored.

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DO NOT GIVE ANYTHING BY MOUTH TO A PERSON WHO IS UNCONSCIOUS, OR HAVING CONVULSIONS.

IF PESTICIDE IS SPLASHED IN THE EYE:

1. Wash the eye with clean water, immediately.
2. Use large amounts of clean water to gently irrigate the eye.
3. Continue for at least 15 minutes.

IF PESTICIDE IS SPILLED ON THE SKIN:

1. Remove all contaminated clothing. Cover the patient with clean clothing or a clean blanket.
2. Wash the skin thoroughly with plenty of soap and water, immediately, and repeat again.
3. Clean under finger and toe nails.
4. Wash contaminated skin with rubbing alcohol.

IF RESPIRATION BECOMES WEAK OR IRREGULAR:

1. Give artificial respiration.
   Maintain breathing and prevent worsening of condition.
2. Oxygen can be beneficial.

ARTIFICIAL RESPIRATION TAKES PRECEDENCE OVER ALL OTHER FIRST AID.

IF CONVULSIONS OCCUR:

1. Keep warm. Keep dry.
2. Prevent injury. Use gentle restraint.

IF UNCONSCIOUSNESS OCCURS:

1. Ensure patient can breath adequately (may need to pull tongue forward to prevent blocking the throat).
2. Keep patient warm and dry.
3. DO NOT GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

IF PESTICIDE IS AN ORGANOPHOSPHATE OR CARBAMATE AND THE SYMPTOMS ARE SEVERE:

1. Two atropine tablets of 1/100 grain or 0.6 mg each should be administered by a medical doctor or under his supervision.

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2. BUT DO NOT give atropine if the patient is already turning blue because of inadequate respiration, or to an unconacious patient.

IF YOU KNOW THE TYPE OF PESTICIDE:

1. Check the appropriate pesticide group for additional first-aid treatment and information.

OBTAIN MEDICAL ATTENTION AS QUICKLY AS POSSIBLE.

Remember to take the label or a labelled container with you.

Remember do not contaminate yourself with pesticide while helping someone else. If you come in contact with the pesticide, wash immediately and take appropriate steps to reduce danger.

CHEMICAL SAFETY

Pesticides application is a very serious business. They can cause illness; and they can kill. The great usefulness of pesticides rests on their ability to interrupt the life processes of insects, fungi, or plants. But many of these toxic chemicals can have dangerous effects on humans and other animals. All should be handled with great respect.

Knowledge is the key. Every person who clearly understands the hazards associated with pesticides will have the incentive to run a "clean" operation.

Each person who is involved in the handling and distribution of pesticides must be vigorously and repeatedly impressed with the seriousness of allowing even a tiny amount of these chemicals to be taken into the body by breathing, swallowing, or absorption through the skin. It is wise to assume that all pesticides may be absorbed through any one of these three routes, and protective measures need to be strictly adhered to with this very much in mind.

Adequate knowledge and rigid application of safe practices are fundamental to the protection of operating personnel, the public, and the environment.

It has been suggested that at least half of all pesticide deaths in the U. S. A. are children under 10 years of age. If pesticides are always handled correctly, children will have no access to them and all of these deaths could be avoided.

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In every instance of pesticide application, someone has to assume responsibility for the conduct of the operations. This management function is important, and should ensure that:

(a) the least toxic but most effective pesticide is used;
(b) that application is at the minimum effective rate, and it is applied on the target area only;
(c) application equipment is regularly maintained and calibrated;
(d) all personnel (including very temporary personnel) are fully briefed on safe procedures, and are properly supervised and protected.
(e) liaison is pre-arranged with local medical facilities;

Arrangements for prompt treatment should be made in advance.

Experience has shown that if proper precautionary measures are observed, even the most toxic compounds can be used safely. Instruction of personnel who handle pesticide chemicals is the most effective way to reduce hazards. It is fundamental that workers at all levels of responsibility be thoroughly briefed in good practice. This means that every person must be fully aware of the properties of the chemicals in use, of proper storage and handling procedures, and of the means for dealing with any emergencies.

It is recommended that copies of the following page should be prominently displayed in every work area, truck, storage area, eating area and washroom.

ACCIDENT PREVENTION:

All personnel should train themselves to observe the following guidelines:

1. Inspect pesticide containers for leaks before handling them.
2. Do not handle containers roughly or carelessly.
3. Should a leak or spill occur, keep people and animals away from the area; decontaminate thoroughly and report immediately to the Supervisor of the Pesticides Control Section, Ministry of the Environment, 135 St. Clair Avenue West, Toronto, M4V 1P5, Telephone: (416) 965-2401.

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4. Inspect vehicles for contamination after unloading; do not permit a contaminated vehicle to leave.
5. Do not store pesticides or empty pesticide containers anywhere near food or drink (including that for animals).
6. Do not keep food, drink, tobacco, cups, or cutlery anywhere in the work areas or in work clothes.
7. Do not eat, drink, or smoke in a work area.
8. Do not rub the eyes or touch the mouth while working with pesticides.
9. Wash hands thoroughly before eating, drinking, smoking or using the toilet.
11. Never fail to discard contaminated clothing or faulty protective covering, especially gloves.
12. Open all pesticide containers carefully, and on a stable surface where they won't tip or spill easily.
13. Open, pour, and mix in a specific area where no person can be contaminated, and where any spills can be cleaned up properly.
14. Use the proper tools to open containers. Use a knife to open paper and plastic bags, and to cut tops. (Don't use a screwdriver or pickaxe, etc., because of the risk of material spurting out onto face and eyes). Ripping open a bag usually causes an uneven tear, thus making spills more likely.
15. Stand upwind of all opening, pouring, and mixing operations.
16. Open, pour, weigh , and mix in a well-ventilated area.
17. Learn how to pour properly from a container. Splashing and spurting can be avoided if a can is held so that the opening is at the top. If an air vent is provided, use it.
18. Wear clean and well-fitted goggles or respirator, (or a face shield), rubber gloves, coveralls, rubber boots and apron for protection in the event of a splash or spill - especially when handling concentrated or highly toxic materials.
19. Coveralls should be worn on the outside of gloves and boots and be long enough to cover wrist. This prevents pesticide from running along the material and into boots or gloves.

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20. Hats, boots, gloves should be washed daily and hung up to dry.

21. Hats, boots, gloves should not be fabric lined as they are hard to clean.

22. Always store pesticides in original labelled container, not in empty food containers, etc.

23. Use care in mixing pesticides. Be sure they are compatable.

24. Be sure you know where to easily and quickly obtain a good supply of lime, coarse clay, sand, sawdust, or other absorbent to soak up a spilled pesticide.

25. Do not permit any person to work alone, especially when handling a highly toxic pesticide.

26. Learn to recognize the typical signs and symptoms of pesticide poisoning.

27. If you fell ill during pesticide application, or shortly after, stop work and seek medical attention at once. Do not carry on because of the work schedule.

28. Never use the mouth to siphon liquid materials or to blow out a clogged spray nozzle.

29. Keep all unprotected persons away from any equipment that may be contaminated. Consider all such equipment dangerous until properly decontaminated.

30. Remember that equipment used for the application of herbicides should be reserved exclusively for that purpose.

31. Make sure that personnel who maintain or clean equipment are aware of the hazards and follow safety procedures similar to those for handling the toxic products themselves. Do not permit anyone unfamiliar with chemical safety practices to carry out cleaning procedures.

32. Change clothes daily, and more often if any contamination occurs.

33. Shower thoroughly, with special attention to hair and fingernails, before going home.

34. Know the limitations of the protective clothing and equipment, especially which respirator cartridge to use and how often to change it. Remember that each person's protective outfit must be complete.

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35. Know that a very serious risk is taken if a victim of pesticides poisoning is allowed to drive home unattended. It is simply not possible to judge the ultimate severity by the initial symptoms. A severe poisoning may seem quite mild at the outset. Once poisoning is suspected, someone should stay with the patient until he reaches medical treatment, and he certainly should not operate a vehicle.
36. Make sure that water, soap and towels are available at the loading site.
37. Be certain to read the label of every pesticide used. These are carefully prepared and carry the necessary information respecting rates, uses, cautions, and hazards. If a label is damaged or illegible, do not use that material. Be sure you know the chemical being used. If seeking medical aid, take the label with you.

SUGGESTED CONTENTS OF FIRST AID KIT

If you plan to work with any pesticide, and especially if you intend to use any of the highly toxic chemicals, you should have available a specially designed first aid kit. This first aid kit may save your life; KEEP IT HANDY. Your first aid kit should include the following:

* Plastic bottle of detergent to wash pesticides off the skin.
* Plastic container of salt to induce vomiting.
* Plastic container of baking soda or bottle of milk of magnesia to neutralize acidic chemicals that have been swallowed.
* Plastic bottle of lemon juice or vinegar to neutralize basic or alkaline chemicals which have been swallowed.
* Bag of activated charcoal to mix with water and swallow to act as pesticide absorber.
* Shaped plastic airway to use for mouth-to-mouth resuscitation.
* Plastic bottle of clean water to dilute the salt, baking soda, lemon juice, or vinegar; also, to mix with charcoal.

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- * Band aids, bandages, and tape.
- * Blanket to cover the victim.
- * Cups for drinking.
- * Dime to make emergency phone calls.

CHEMICALS AND FORMULATIONS

Chemicals used for the control of insects, weeds, and plant diseases are biologically active compounds. A wide variety of these chemical compounds - generally known as "pesticides" - is available, and a clear understanding of the distinctions between them is essential to proper management.

In order to help clarify and manage a vast amount of information, three classifications are employed, namely: (1) by purpose, (2) by formulation, and (3) by chemical composition. All three need to be described for any one case. Item (3) is the active ingredient and may be given as the chemical name or a trade name. Item (1) may also be descriptive of the mode of action of the chemical.

It is necessary to use these three joint classifications in order to maintain a clear understanding of complex subject matter, and thus the correct utilization of control chemicals.

CLASSIFICATION BY PURPOSE

The broad division of "pests" into insects, weeds, and fungi naturally evolves the terms (a) insecticides, (b) herbicides, and (c) fungicides.

HERBICIDES

These chemical compounds used to kill or inhibit undesirable plant growth may be sub-divided in accordance with their selectivity and mode of action:

A - CONTACT HERBICIDES

Contact herbicides are those that kill primarily by contact with plant tissue, rather than as a result of translocation. Only that portion of the plant contacted is directly affected, and the effect is usually rapid. Complete coverage is necessary for complete control.

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B - SYSTEMIC OR TRANSLOCATED HERBICIDES

Systemic or translocated herbicides act more slowly, taking perhaps several weeks for maximum effect, and are capable of movement within the plant away from the site of application.

C - GROWTH REGULATORS

Growth regulators alter the growth characteristics of plants. Careful timing and application are necessary.

Herbicide treatments are either:

NON-SELECTIVE:	to kill or suppress all vegetation in the treatment area.
SELECTIVE:	to kill or suppress some plants without affecting others.

SELECTIVE HERBICIDES may also be classified according to the time of application, as follows:

1. PRE-PLANT HERBICIDES
   These are applied to the soil before seeding of the crop. (Some types must be incorporated into the soil after application).
2. PRE-EMERGENT HERBICIDES
   Pre-emergent herbicides may be applied following seeding of the crop, pre-emergent to the crop only, or pre-emergent to both crop and weeds.
3. POST-EMERGENT HERBICIDES
   These are applied following emergence of the crop, or weeds, or both.

A. SOLUTIONS

When a chemical compound (dry or liquid) is dissolved in a liquid, the result is a solution. Such a solution may be in water, or in an organic solvent. Most pesticides are relatively insoluble in water, and must be dissolved in an organic solvent before being added to the water.

B. EMULSIONS (FROM EMULSIFIABLE CONCENTRATES)

Oil solutions which are intended to be diluted with water are formulated as a concentrate, with emulsifying agents added to permit the oily product to disperse in water to form an emulsion. This gives the thin, milky liquid which is characteristic of an emulsion by which the oil-carried pesticide is dispersed through the water diluent.

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C. INVERT EMULSIONS (FROM EMULSIFIABLE CONCENTRATE)

In this case a water solution is formulated as a concentrate and dispersed in oil to form an emulation; that is, the water-carried pesticide is dispersed through an oil diluent. This results in a thick mayonnaise-like mixture, which is used when drift control is of prime importance.

D. WETTABLE POWDERS

Wettable powders are formulated by mixing the active ingredient into a clay-like powder, together with special wetting agents. When mixed with water ready for use, the result is a suspension; which usually requires constant agitation to maintain a uniform mixture.

E. DUSTS

Dusts consist of clay-like materials to which have been added appropriate amounts of active ingredient, and thoroughly mixed. Dusts are intended to be used exactly as supplied, without further dilution or mixing.

F. GRANULES

Granules are formulated by mixing the active ingredient with a clay-like material, in a process which yields relatively large particles or granules carrying the required level of pesticide. Granules are used to facilitate placement of the active ingredient, and can be especially prepared to suit particular circumstances.

NOTE: ADDITIVES

Additives or adjuvants of various kinds are available to modify or improve the properties of the spray liquid according to need, particularly in the case of solutions. Spreader-stickers are additives which will help the spreading and adhesive properties of the spray solution. Thickening or foaming agents may be added to a spray solution to produce a viscosity that is useful in reducing the number of fine particles in the spray cloud. Several varieties of these adjuvants are available.

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CLASSIFICATION BY CHEMICAL COMPOSITION

Biologically active chemical compounds for pest control may be initially classified into two main groups:

A. INORGANIC COMPOUNDS

Inorganic compounds do not contain carbon and are usually derived from mineral ores, extracted from the earch. The most common compounds used today are derivities of copper, sulphur, zinc, phosphorous; i. e., copper sulphate, zinc phosphide, aluminum phosphide.

B. ORGANIC COMPOUNDS

Organic compounds contain carbon atoms in their chemical structure. They are most synthesized from basic chemicals but some are extracted from plants and these are called "botanicals" or natural products. These organic compounds can be divided into various groups or families of chemicals. Each group contains chemical compounds which have some common charastics, and one group may contain insectivices, herbicides and fungicides. The following are some of the major organic chemical groups:

GROUP 2 ORGANOPHOSPHORUS COMPOUNDS

The organophosphate compounds are derivatives of phosphoric acid. They contain phosphorus, carbon, and hydrogen; some also contain sulphur and oxygen. With a few notable exceptions, the group is acutely toxic, and all act as cholinesterase depressants. Most of the group are insecticides, and some of them are herbicides also. This group is less persistent in soil, food and feed for animals; many are combustible. Common members of the family which are herbicides are Roundup and Betesan.

GROUP 3 CARBAMATE COMPOUNDS

This family of compounds is typified by a particular arrangement of nitrogen, carbon, and oxygen in the chemical structure. Members of the group are: herbicides - propham, triallate, barban, Eptam, and also several fungicides and insecticides.

The chemicals of this group are, in general, less persistent in the environment. The toxic hazard to humans and animals is mild with the above herbicides and fungicides, but the insecticides have a greater toxicity.

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GROUP 4 CHLOROPHENOXY COMPOUNDS

The chemical nature of this family is characterized by a phenol ring to which is attached a number of chlorine atoms and a variety of organic acids. Virtually all are herbicides, and members of this group are among the most widely used herbicides due to their value in weeding grain crops. They are selective in that grasses (as well as a few other crop species) are physiologically resistant to them. The most common members of the group are 2,4-D, MCPB, 2,4,5-T, and MCPA: all have low to moderate toxicity to humans and animals. Some formulations are sufficiently volatile to cause a risk to damage due to vapour drift.

GROUP 5 DINITROPHENOL COMPOUNDS

Dinitrophenols derive their name from a phenol ring to which are attached nitrogen-oxygen radicals. Belonging to a family of dye chemicals, they are a strong yellow in colour, and stain any organic material with which they come in contact. This group is considered to be quite toxic, and may be employed as herbicides, insecticides, and crop desiccants. The most common member of the group is dinoseb.

GROUP 6 SUBSTITUTED UREAS

This group of herbicides is mildly toxic to humans and includes fenuron, monuron, and diuron. The earliest compounds in this group were non-selective, long-term residual weed killers, usually applied to the soil. More recently developed compounds, such as linuron and chloroxuron, are more selective and may be applied postemergent to the crop.

GROUP 7 TRIAZINES

The chemical compounds in this group are all herbicides of mild toxicity to humans and include atrazine, simazine, propazine, prometon, prometryne, desmetryne, and amitrole. They all appear to affect photosynthesis following uptake by the root system, and those with a higher water solubility may also enter through the foliage. Residues from these compounds are noted for their persistence in the soil.

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GROUP 10

TRICHLOROBENZOIC, TRICHLOROACETATE, AND TRICHLOROPICOLINIC

This group is relatively non-toxic to humans and includes TBA, TCA, and picloram. However, TCA will cause burns from prolonged skin contact, and picloram is combustible. All are herbicides with long soil residue properties.

GROUP 11 CYCLOHEXENES,PHTHALIMIDES, AND PROPRIONICS

This group includes captan and folpet (fungicides) and dalapon (herbicide). All are mildly toxic to humans.

GROUP 12 PYRIDYLIUM

This group are herbicides and include diquat and paraquat. Both diquat and paraquat are liquid herbicides absorbed through the leaves and are capable of the rapid removal of foliage; they should be considered very toxic to humans.

GROUP 13 HYDROPHTHALIC

This group is very toxic to humans and includes ~~ed~~endothall, a herbicide mainly used for aquatic weed control.

TOXICITY

Since most chemical pesticides have some degree of toxicity to man, everyone who works in pest control should be aware of the potential hazards which accompany their use.

Many pest control compounds are two-edged swords; because they are not selectively toxic only to the intended victims, and are highly poisonous to humans and animals.

Prevention of overexposure is undoubtedly the best insurance against poisoning. The most potent pesticides may be safely handled if enlightened and disciplined adherence to good practices is ensured.

HAZARDS

The majority of herbicides are less toxic than insecticides. The major risk is to sensitive crops in adjacent areas, and thus drift of herbicide sprays has to be avoided. Spray tanks must be thoroughly cleaned of herbicide formulations before they are used for other pest control purposes.

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Pesticides vary widely in their toxicity. It is also important to note that some have only an acute toxicity, some are only chronic in nature, and some have both acute and chronic effects. It is also known that toxicity may vary with the type of formulation used, with the route of absorption into the body, and with the body weight. The susceptibility of humans to poisoning by a pesticide will also differ with age, sex and nutritional state.

LETHAL DOSE 50% (LD$_{50}$)

The accepted method of recording the relative toxicity of a pesticide is the Lethal Dose 50% (LD$_{50}$) value. This is a statistical estimate of a chemical dose which, when administered, will kill 50% of the test animals under stated conditions. This is the accepted yardstick used to denote hazard, but care must be exercised in its interpretation.

The figures which designate the LD$_{50}$ values are expressed in milligrams of dose per kilogram of body weight of the test animal. The chemical dose to kill a 2000 pound horse will be about 10 times the same relative dose for a 200 pound foal. (The LD$_{50}$'s will be approximately the same for the foal and the horse). For any one group of test animals of the same species, therefore, the weight of each animal has to be determined.

The test animal may be a rat, dog, bird, or fish, but very rarely is LD$_{50}$ information available for humans. The LD$_{50}$ values are seriously affected by the age of the test animals and strains of the same species may react very differently to the same treatment. For this reason, the LD$_{50}$ values developed for one species only begin to inspire confidence after numerous tests have been conducted by many workers under varying conditions. It is because pesticides are selective in their action, and therefore different species of animal life react differently to such a degree, that the compounds are useful. Thus, the LD$_{50}$ values for rats or dogs may have little bearing on the value for birds or humans. Nevertheless, LD$_{50}$ values are very useful in classifying pesticide chemicals according to their toxicity, so long as it is recognized that the values are not absolute and should be expressed as a range.

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Toxicity also varies with the route of absorption into the body. LD_{50} values may therefore be determined for different routes of administration; the oral, dermal, and respiratory routes being of most practical significance.

Another way of expressing relative toxicity is employed in the case of fish (and may also be used with birds and wildlife of low body weight). This is the Lethal Concentration 50% (LC_{50}) value expressed as parts per million (ppm). In the case of fish, this value is the ppm of chemical (active ingredient) in the water for a certain period of time (usually 24 hours) which will kill 50%.

Also an LC_{50} value in air is used in connection with the poisoning of mammals by inhalation.

In all cases, the higher the value given for LD_{50} or LC_{50} the less toxic the material.

TOXICITY OF SOLVENTS

Some solvents and adjuvants are themselves toxic; skin irritation, in particular, may be due to the solvent and not the pesticide. Some adjuvants are highly toxic and must be stored and handled with the same care as the technical material.

TOXICITY TO HUMANS

Should an accident occur in which someone is doused with a pesticide and almost immediately goes into a coma, then there is no doubt about the cause of the illness and proper treatment can be administered. A more insidious problem occurs with mild, slow poisoning over a period of time: the symptoms are less severe and frequently difficult to distinguish from the results of the normal stresses of life.

Thus chronic toxicity is just as important as acute toxicity.

Furthermore, the greatest risk to operators engaged in the application of pesticides occurs if an episode of acute poisoning (due to a spill or lack of protective gloves, for instance) is superimposed upon a condition of chronic poisoning.

MEANS OF ABSORPTION

(1) Oral

The mouth and alimentary canal is one route by which a

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pesticide can be absorbed. Such poisoning may occur because of an accident, but is more frequently due to inexcusable carlessness. The blowing out of plugged nozzles, smoking or eating without washing, or the contamination of food or cutlery, are common examples of this. Good hygienic practices and frequent washing are always essential when handling or applying pesticides.

(2) Dermal

The most common risk of absorption of a pesticide is through the skin. Skin contamination can occur easily, and is often not detected until symptoms have developed. It is important to remove the pesticide from the skin as quickly as possible. The danger of skin absorption is always greatest when the temperature is high and the skin is wet with perspiration. Dermatitis may also increase the risk of absorption.

Dermal Exposure

Dermal exposure can occur any time a pesticide is mixed, applied, or handled. Its seriousness depends upon (1) the dermal toxicity of the material: (2) the rate of absorption through the skin: (3) the size of the skin area contaminated: and (4) the length of time the material is in contact with the skin.

Rates of absorption through the skin are different for different parts of the body. Using absorption through the forearm (1.0) as the standard, absorption is over 11 times faster in the lower groin area. Absorption through the skin in the scotal area is rapid enough to approximate the effect of injecting the pesticide directly into the bloodstream. At this rate, the absorption of pesticide through the skin into the bloodstream is more dangerous than swallowing it.

You should also be aware that it is not only the pesticide that is dangerous. Many pesticides are carried in oil-based materials. If this oil gets into the bloodstream, the results can be fatal. The oil crosses the skin barrier as rapidly as the pesticide in highly sensitive parts of the body. Wear rubber aprons or rubber trousers to protect the lower parts of the body.

Absorption continues to take place through all of the affected skin area as long as the pesticide is in contact with the skin. The seriousness of the exposure is increased if the contaminated area is large, or if the material remains on the skin for a long period of time.

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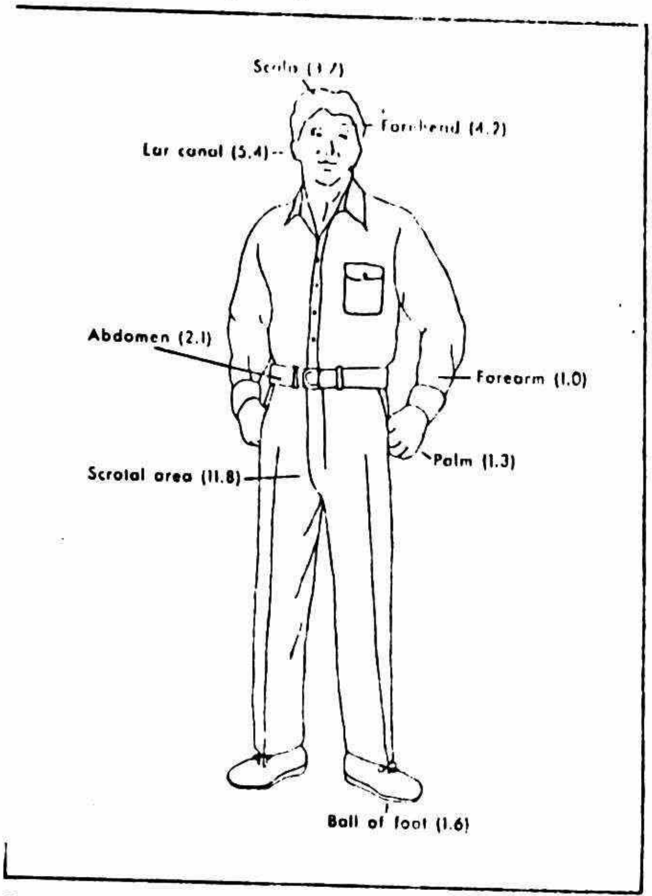

Dermal absorption rates as compared with the forearm.

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Dermal.

TABLE 2. ~~CHEMICAL CLASS, USES, AND~~ TOXICITY OF COMMON HERBICIDES

Herbicide Trade Name	Common name	Skin irritation
SEVERE IRRITATION OR SKIN ABSORPTION		
Endothal, Hydrothal, Aquathol	endothal	severe
Randox, Randox T	CDAA	severe
MODERATE IRRITATION OR SKIN ABSORPTION		
Diquat	diquat	moderate
Dow General, Sinox, Preemerge	dinoseb	moderate
Paraquat, Gramoxone	paraquat	moderate to severe
many	sodium chlorate	moderate to severe
Ramrod	propachlor	moderate to severe
Sodium TCA	TCA	severe
Urox	monuron-TCA	moderate to severe
MILD IRRITATION OR SKIN ABSORPTION		
Ammate-X	AMS	mild
Basagran	bentazon	mild
Borox, Borascu	sodium borate	mild
Brominal, Buctril	bromoxynil	mild
Daconate, Ansar 529,170	MSMA	mild
Dowpon, Radapon	dalapon	mild
Hyvar-X	bromacil	mild
Lasso	alachlor	mild to moderate
Lorax	linuron	mild
Phytar 560, Silvisar 510	cacodylic acid	mild
Pyramin	pyrazon	mild
TOK	nitrofen	mild
Tupersan	siduron	mild
MAY CAUSE IRRITATION TO CERTAIN PEOPLE		
Banvel	dicamba	mild
Benzac, Trysben, Fen-all	2,3,6-TBA	mild
Karmex	diuron	mild
Kuron, 2,4,5-TP	silvex	mild
Telvar	monuron	mild
many	DSMA	mild
many	2,4-D	mild
many	2,4,5-T	mild

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(3) Inhalation

Absorption through respiration is an important route when sprays or dusts are actually being applied. It can also occur where mixing is being done in confined areas; therefore, the preparation of formulations inside buildings should be avoided.

A particular danger exists with highly toxic substances which vaporize readily.

PRECAUTIONS TO BE TAKEN

Sensible and practical precautions to avoid unnecessary exposure should always be followed. Good personal cleanliness should always be maintained. It should be anticipated that accidents from broken hose connections, spillage or dripping nozzles etc., can and will occur; provision must be made for the immediate change of contaminated clothing and thorough washing.

RELATIVE TOXICITY

The LD_{50} values quoted are based on the active ingredient and not on the formulated product nor the spray-tank mixture. The formulating and proper tank mixing reduces the toxicity of these chemicals considerably.

A comparative classification of hazard and corresponding probable lethal dose values of technical material for a 150 lb. (70 kg.) human adult is as follows:

LD_{50} VALUE	HAZARD RATING	
0-50	High	Less than 1 tsp.
50-500	Medium	up to 1 ounce
500-2500	Low	up to ½ pint
2500	Very Low	up to 1 pint

The acute oral LD_{50} values for some common drugs and materials are as follows, and may be compared with the values given above for pesticides:

CHEMICAL	ORAL LD_{50} VALUES
aspirin	1750
Gravol	500
strychnine	20
amphetamine	5
ethylene glycol (anti-freeze)	3500
phenobarbitol	660
ethyl alcohol	13700
common salt	3300

Each group of chemical compounds has its characteristic set of effects on humans. The organophosphates and carbamates are similar in many respects, but the chlorinated hydrocarbons are quite different in that they are cumulative in the body tissue.

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ORGANOPHOSPHATES AND CARBAMATES

The organophosphate and carbamate pesticides do not become stored in body fat; thus mild exposures at infrequent intervals usually do not result in cumulative effects within the body. Nevertheless, there is always a danger from repeated small exposures to these types of pesticide, which may lower the acetyl cholinesterase level without producing serious symptoms, or even any symptons at all. This is believed to be a frequent cause of accidents.

In general, the organophosphorus and carbamate compounds result in acute toxic reactions. Once the patient has been removed from further exposure to the compound, recovery is usually rapid; there are usually no serious after-effects, provided that renewed exposure is avoided. Both the organophosphate and the carbamate compounds inhibit the enzyme acetyl cholinesterase in the nervous system, but the carbamates generally present less serious problems than the organophosphates.

The rate at which the cholinesterase level is depressed is important if it occurs suddenly as a result of the rapid absorption of small doses of the toxicant. A sudden marked depression resulting from larger doses can lead to a critical condition.

CHOLINESTERASE LEVEL

When a signal goes from the brain to initiate movement of a muscle, it must pass through a number of nerve junctions. At each junction, a chemical mediator is released at one nerve ending to stimulate the next nerve, and then is quickly destroyed so that its action does not persist. The mediator is acetylcholine and, immediately after discharge, it is broken down into acetyl and choline components. The compound that accomplishes this breakdown is an enzyme known as acetyl cholinesterase.

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The term cholinesterase refers to a number of enzymes that have the ability to split, or hydrolize, esters of choline. Acetyl choline is an important chemical mediator and is found through the central nervous system, at various junctions in the nervous system, and also at many nerve terminations in various glands and muscles through the body (such as in the eyes, in the gastrointestinal tract, and in the lungs). Normally, acetyl choline is rapidly destroyed by acetyl cholinesterase as soon as it has accomplished its task. More acetyl choline is formed as needed for the next nerve impulses. Acetyl choline and the cholinesterase enzymes are in a delicate state of balance, interacting to modulate the complex nervous system in controlling body functions.

But if the acetyl cholinesterase is not functioning, the acetyl choline builds up and the system is in trouble.

The cholinesterase can be inactivated by organophosphate or carbamate poisoning. The symptoms which then occur are all due to the fact that, as a result, nerve impulse transmission races out of control because of the buildup of acetyl choline at the ends of nerve fibers. A variety of clinical signs and symptoms results, depending on the severity of poisoning and the system which is most affected.

However, the cholinesterase level may also be decreased in other types of tissue and in the blood serum, which therefore can be used as an index of poisoning. (The level in the blood can be lowered considerably without seriously affecting normal functions). At least two types of cholinesterase exist in the body. That which splits only acetyl choline is also found on the surface of red blood cells, and is known as "red cell cholinesterase." Another type which splits other choline compounds as well is known as "plasma cholinesterase." The activity of both enzyme types can be measured accurately with suitable laboratory procedures. Exposure to organophosphate or carbamate pesticides can thus be estimated by measurement of cholinesterase activity in the blood.

The blood cholinesterase test is of value in two ways. Firstly, it is extremely valuable and reliable in diagnosing cases of poisoning by organophosphate or carbamate compounds. Secondly, regular tests are of value in monitoring the cholinesterase level of personnel using organophosphate or carbamate pesticides, and thus warning of impending intoxication. Such testing forestalls illness in a worker who is unduly exposed day by day and gradually approaches a state of clinical poisoning.

However, routine blood cholinesterase tests should not be relied upon as ensuring complete safety or overlooking the need for absolutely safe procedures. The test cannot (as yet) be carried out daily and therefore cannot provide the day-to-day protection of personnel.

An additional advantage of a routine testing schedule, say every ten days, of personnel regularly exposed to organophosphate or carbamate

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pesticides is that it is possible to identify those individuals or steps in the procedures that represent weak spots in the safety programme.

In order to be able to use the blood cholinesterase test (either in an emergency or on a routine check basis), it is essential to have the normal pre-season level of each person determined. Only then is it possible to know if the level has become depressed. There is no standard level of cholinesterase; it varies very widely among different people. The normal level for each individual must be known at the beginning of the season.

A low cholinesterase reading may not necessarily be due to exposure to a pesticide, but critical poisoning in man is always accompanied by a drastic reduction in cholinesterase levels; and in every case, the normal level, the exposure history, the symptoms and the clinical findings have to be taken into consideration.

In the absence of additional absorption or of medical treatment, the cholinesterase enzymes regenerate slowly. Red cell cholinesterase usually requires about 120 days to return from very low to normal values, while plasma cholinesterase (which is manufactured by the liver) returns to normal in about 30 days. If additional exposure to organophosphates or carbamates occurs during the "recovery" period, the further inhibition of the enzymes will prolong the regeneration to normal levels. This has important implications for workers who may sustain a series of exposures during the season.

Because, in general, a carbamate - cholinesterase combination is less stable than organophosphate - cholinesterase, the effects of carbamate exposure tend to be not so long-lasting as the symptoms that follow organophosphate intoxication. With some carbamates, the cholinesterase level returns towards normal very quickly and, because of the short duration of the depression, a blood cholinesterase test may be of little value as an indication of poisoning, unless taken immediately. For further information, please contact the staff of the Pesticides Control Section, Ontario Ministry of the Environment.

TOXICITY TO FISH AND WILDLIFE

Pesticides which are potentially hazardous to fish and wildlife can cause serious effects if improperly applied. If the application of pesticides results in losses to fish or wildlife, the Ministry of the Environment must be notified immediately. A list of telephone numbers that you can contact are attached. Prompt reporting can bring about an immediate investigation of damage and any remedial action possible. The Ministry of Natural Resources and the Ministry of Health should also be informed.

PRECAUTIONS TO BE TAKEN

The following precautions must be taken by every applicator to ensure that his actions are not contributing to any effects on fish and wildlife:

(1) Do not exceed prescribed application rate.

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(2) Do not apply pesticides to areas under irrigation, where runoff can enter streams, canals, ditches or lakes containing fish.

(3) Do not spray if pesticides can directly drift into streams, lakes, rivers, or ponds containing fish.

(4) Do not wash spray equipment in streams.

(5) Use an approved back-flow device when filling spray tanks from streams.

TOXICITY TO FISH

Several pesticides are very toxic to fish. Of the common herbicides, the following are the most toxic:

acrolein, bromoxnil, captafol, chlorbromuron, Copper Sulphate, dinitramine, pentachlorophenol, sodium chlorate.

TOXICITY TO HONEY BEES

Many pesticides are toxic to honey bees and other beneficial insects. The farmer, bee keeper, and pest control operator must co-operate closely to keep the losses of beneficial insects to a minimum. For the protection of these insects, only the safest materials should be used.

PRECAUTIONS TO BE TAKEN

(1) Use the proper dosage of the safest material that will give good pest control.

(2) When using materials hazardous to bees, notify the bee-keeper so that he can confine them in the hives.

(3) Dusts are, as a rule, more hazardous to bees than are sprays.

(4) Repeated applications cause greater bee losses.

(5) Treatments when bees are foraging in the field are to be avoided. Applications made in hot weather, when bees are clustering on the outside of the hives for fanning purposes, may cause severe losses. Treatments made during the evening, or early in the morning before bees are foraging, are the safest.

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(6) The drift of hazardous chemicals onto neighbouring fields attractive to bees may causes losses.

(7) Hives returned to a field after the pesticide treatment usually suffer fewer losses than hives left in the field when it is sprayed.

The following herbicides are highly toxic to bees:

dicamba (Diclear)
prometone (Primatol)

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The following pages contain tables of LD_{50} values of pesticides that have been used or are currently being used in Ontario. The data quoted refer to laboratory tests with rats, except where rabbits were used for dermal tests, shown as (Rb). The figures shown should be considered as relative indicators rather than absolute values, as the data quoted originated from many sources.

You must know the common name of the chemical in order to use the tables. The common name is listed on the label and in the study material supplied to you.

RELATIVE TOXICITY OF PESTICIDES

Common Name	Trade Name	LD_{50} (mg/kg) Oral	Dermal	Chemical Group
Herbicides				
acrolein	Aqualin	46	562 (Rb)	aldehyde
alachlor	Lasso	1200	3500 (Rb)	acetanilide
allidochlor	Randox	700	360	acetamide
amitrole	Aminotriazole	14,700	>10,000	triazine
ammonium sulfamate	Ammate X	3900		
ametryne	AA top	1405	5600 (Rb)	triazine
asulam	Asulox	>8000	>1200	carbamate
atrazine	AAtrex	3080	7500 (Rb)	triazine
1,2-dimethyl-3,5-diphenyl pyrazolium ion	Avenge	320-450	770 (Rb)	
aziprotryn	Mesoranil	3600	>3000	triazine
barban	Carbyne	600	>1600	carbamate
benazolin	Tricornox	>3000		
benefin	Balan	>800		dinitroaniline
bensulide	Betasan	770	3950	organophosphorus
bentazon	Basagran	1100	2500	diazine
benzoylprop ethyl	Endaven	1555	>1000	
boracic acid		3000		
bromacil	Hyvar	5200	5000 (Rb)	urea
bromoxynil	Buctril	190-270	>3660 (Rb)	nitrile
butylate	Sutan	3997-4659	>2000 (Rb)	carbamate
cacodylic acid	Phytar	830		arsenic
carbutylate	Tandex	3000	>15,400	carbamate

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Common Name	Trade Name	LD$_{50}$ (mg/kg)		Chemical Group
		Oral	Dermal	
chloramben	Amiben, Vegiben	5620	>3160	benzoic acid
chlorbromuron	Maloran	820	3000	urea
chloropicrin	Picfume	0.8		
chloroxuron	Tenoran	3000	>10,000	urea
chlorpropham	CIPC	5000-7500	10,200 (Rb)	carbamate
chlorthal	Dacthal	>3000	>10,000 (Rb)	phthalic acid
cutrine		8680		copper complex
cyanazine	Bladex	149	>1200	triazine
cycloate	Ro-Neet	2000-3190	2000 (Rb)	carbamate
cyprazine	Outfox	1200±200		triazine
2,4-D amines, salts and acids		300-1000	800-1500	phenoxy
2,4-DB (butyl ester)	Embutox	700-1500	800	phenoxy
dalapon		3860-9000	>2000 (Rb)	propionic acid
desmedipham	Betanol-475	>10,250		carbamate
diallate	Avadex	395	2000-2500 (Rb)	carbamate
dicamba	Banvel	1040	>1000	benzoic acid
dichlobenil	Casoran	2710	1350 (Rb)	nitrile
dichlorfopmethyl (proposed)	HOE - Glass	557 - 580	>5000	phenoxy
dichlorprop	2,4-D-P	800		phenoxy
dinitramine	Cobex	3000	>6800 (Rb)	dinitro comp'd.
dinoseb	Premerge	5-60	135-200	dinitro comp'd.
diphenamid	Dymid	1000	6320	acetamide
diquat	Reglone, Aquacide	400-440	>500	pyridylium
disul	2,4-DES	730-1400		phenoxy
diuron	Karmex	3400		urea
disodium methyl arsonate	Ansar 184	600		
EPTC	EPTAM	1630	1460	carbamate
ertom	Baron	1120		phenoxy
endothall	Aquathol, Hydout	38-206	750	phthalic acid
fenuron	Dybar	6400		urea
fenoprop salts and amines	Silvex	500-1000		phenoxy

Common Name	Trade Name	LD$_{50}$ (mg/kg)		Chemical Group
		Oral	Dermal	
ferrous sulphate	Green Vitrol	5000		
fenac		1780-3000	> 3160 (Rb)	phenylacetic acid
flamprop-methyl	Metaven	1210	> 2800	amino-propionate
	Hammer (Erbotan)	278	2150	urea
glyphosate	Roundup	4320	> 7940 (Rb)	organophosate
ioxynil	Totril	110		nitrile
Kerb		5620-8350	> 3160 (Rb)	
	Krenite	10,200	> 1683 (Rb)	carbamate
linuron	Lorox	1500-3000		urea
MCPA (amines, esters and salts)		700-1000	> 1000	phenoxy
MCPB salts	Tropotox	680	1000	phenoxy
mecoprop salts	Compitox	930	900 (Rb)	phenoxy
metam (sodium)	Vapam	97	800 (Rb)	carbamate
metribusan	Sencor	1937-2345		triazine
methyl bromide		1 mg/litre^{3}		
methyl isothiocyanate	Vorlex	175-300	2780	
metobromuron	Patoran	2000	> 10,000 (Rb)	urea
metolachlor	Primextra	2780	> 3170	acetamide
monolinuron	Afesin, Aresin	2100		urea
monosodium acid methane arsonate	Ansar 170	700-1800		arsenic
monuron	Telvar	3500-3700	> 2500	urea
monuron - TCA	Urox	2300-3700		
naptalam	Dynap	1700-8500		phthalic acid
neburon	Kloben	11,000		urea
nitralin	Planavin	1000-2000	> 2000 (Rb)	dinitroaniline
nitrofen	TOK-E-25	2630-3580		nitrophenyl
paraquat	Gramoxone	157-207	> 480 (Rb)	pyridinium
pebulate	Tillam	921-1120	2936 (Rb)	carbamate
pentachlorophenol	PCP	27-80	150-350	CH
phenmedipham	Betanal	> 8000	> 4000	carbamate
picloram amines and salts	Tordon	3080	> 4000 (Rb)	picolinic acid
prometone	Primatol	2245-2980		triazine

CH - chlorinated hydrocarbon

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Common Name	Trade Name	LD_{50} (mg/kg)		Chemical Group
		Oral	Dermal	
prometryne	Gesagard	3750	>1000	triazine
propachlor	Ramrod, Ramdox	710		acetanilide
propanil	Stam F-34	560-1384	7080	acetanilide
profluralin	CGA - 10832	2200 (46% E.C.)	>10,250 (46%E.C.)	dinitro aniline
propham	IPC	5000		carbamate
pyrazon	Pyramin	3600		pyridazone
siduron	Tupersan	>5000		urea
simazine	Princep	5000	>8160 (Rb)	triazine
sodium chlorate, mixtures		5000	>10,000	
solan	Pentanochlor	>10,000	10,000 (Rb)	acentanilide
sulfallate	Vegadex, CDEC	850		carbamate
2,4,5-T amines	numerous	300		phenoxy
terbutryn	Topogard	2000-2980	>10,200	triazine
tebuthiuron	Spike, Preflan	596-720		urea
terbacil	Sinbar	>5000	>5000 (Rb)	urea
terbutol	Azak	>10,250	>15,000	carbamate
terbuthylazine	Gerdoprim	2000	4000 (Rb)	carbamate
triallate	Avadex TW	1675-2165	2225 (Rb)	carbamate
trichloracetic acid	TCA	5000		
trichlorobenzoic acid		750-1000	>1000	benzoic acid
trifluralin	Treflan	3700	>5000	dinitroaniline
vernolate	Vernam	1710	>2995 (Rb)	carbamate
	Velpar	1690	≥5278	triazine

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STORAGE

(1) Pesticides should always be stored in a cool, dry, locked, well-ventilated area without floor drains.

(2) Store away from food and drink used for human and animal consumption.

(3) Herbicides should be stored separately from other types of pesticides to prevent cross-contamination.

(4) Always store pesticides in their original containers.

(5) A sign with the words: "Chemical Storage Warning - Authorized Persons only" in block letters clearly visible should be placed on the outside of each entrance leading into the storage area. Protective clothing, a respirator, and a first aid kid should be available in the storage area.

DISPOSAL

All empty containers and unused amounts of pesticides must be securely held in an isolated storage area until they can be disposed of correctly. Immediately after emptying a container, rinse several times with the same diluent as used for mixing. Pour the rinse into the spray tank load. Crush empty pesticide containers and bury under at least 18 inches of soil away from water.

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DRIFT OF PESTICIDES

A basic principle of pest control is the application of a pesticide to the host plant, host area or directly on the pest to control undesireable insects, plants, fungi, or diseases. The safe and efficient use of pesticides necessitates that pesticides land on the target area. The portion of the spray that drifts may lead to erratic pest control within the target area or environmental problems.

WHAT IS DRIFT?

Drift is the movement of particles or droplets off of the target. There are two types of drift - vapour drift and spray drift:

Vapour Drift:	is the movement of vapour which results from volatilization or evaporation of the pesticide. The evaporation may occur from the droplets at the time of application or from the pesticide deposited on the plants or surrounding soil surface after the application.
Spray Drift:	is the movement of droplets of pesticide from the target during the application because of wind, air currents or other factors. The larger droplets are moved only a short distance but small particles may remain suspended on air currents and can be deposited at a distant point.

WHAT FACTORS AFFECT DRIFT?

The factors which cause drift are very complex and involve the interrelationship of such factors as wind velocity, air pressure, temperature, height of the spray nozzles and size of the holes in the nozzle head.

1. Wind: If the wind speed is greater than 7 m.p.h. some of the spray may drift away from the target area.

2. Droplet Size: As the spray droplet size becomes smaller, drift is more likely to occur. The droplet size can be altered by the choice of spray nozzle on the equipment and the pressure at which the pesticide is applied. Generally, higher pressure produces finer droplets which are more likely to drift.

3. Temperature: With warmer temperatures, evaporation of the spray increases; thereby, increasing the possibility of vapour drift.

4. Distance Between Nozzle and Target Area: As the distance between the nozzles and the target increases, the possibility of drift increases.

The pesticide spray applied should land on the target. However, it could land in the target area but not on the target; it could drift

....33

outside the target area, of after application, pesticide could drift **through** evaporation. Several problems should be considered:

1. Adjacent Crop Damage: When spraying the target area, drift can damage susceptible crops. This is a consideration when using herbicides; for example, a herbicide for broad-leafed weeds will also destroy such crops as tomato, soya bean, and grapes. As well as crop damage, drifting pesticide can contaminate crops ready for harvest, leaving unacceptably high residues on the produce.

2. Water Contamination: When drift occurs onto ponds, streams or other bodies there may be a resulting taste or odour. Also, this contamination could be a source of future crop damage if the water is used for irrigation purposes or result in a fish kill.

3. Improper Pesticide Application: This may endanger pollinating insects, animals or humans. Special consideration should be given to the safety of the applicator.

4. Improper Pesticide Levels: If drift occurs to a non-target area, the amount of pesticide applied to the target area is reduced below the recommended quantity and may not be effective.

OPERATIONAL TECHNIQUES WHICH WILL REDUCE DRIFT

1. Spray when the wind is less than 7 miles per hour. (Pay special attention to the label for particular weather conditions).

2. Use nozzles that apply higher gallonage. This helps to reduce drift within the limitations of the machine. Keep nozzles and pressure equipment clean and in good repair.

3. Use the nozzle-type which will give larger droplet size and reduce the distance between the nozzle and the target when spraying.

4. Do not use high pressure pumps in the spray equipment because smaller droplets will be produced, increasing the chance of drift.

5. Consider a less volatile material near susceptible crops to decrease vapour drift. Since water based chemicals evaporate faster than oil based chemicals, special consideration should be given to the oil based material near susceptible crops. In this case, special thickening agents could be used, especially when using herbicides. Also, the same pesticide may be available in several chemical forms which vary in volatility - for example, 2,4-D ester is more volatile than 2,4-D amine. Follow methods of application on the labels.

6. Other formulations and techniques may be as effective. A granular formulation applied to the target may produce the same result as a liquid but reduce chances of drift. As well, mechanical removal of some pests such as brush, may reduce or eliminate the need to use a pesticide.
7. Follow methods of application on the label.
8. Replace faulty nozzles and clean partly plugged nozzles which may cause fogging.

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DECONTAMINATION OF APPLICATION EQUIPMENT

The decontamination of tanks, booms, and nozzles is very important. Equipment should be decontaminated when pesticide changes are made and at the end of the season. Many cases of poisoning and damage to crops have occurred from contaminated equipment. Never mix insecticides and herbicides in the same tank or apply them from the same equipment.

Dilute the chemical with lots of water being careful where the wash water drains. Most pesticides degrade in an acid or alkaline medium. The following groups of chemicals should be treated as follows:

(a) Organophosphates

A solution of washing soda and "javex" will remove organophosphate residues. Care must be taken in using strong solutions, and they should be followed by at least two washings with clean water.

(b) Chlorophenoxy Compounds

After the use of herbicides such as 2, 4-D or 2,4,5-T, it is necessary to remove the chemical completely from the system, to prevent contamination of the next charge of spray and thus damage to crops. However, complete decontamination is generally considered impossible for these compounds. If the same equipment must be used for the application of other chemicals, the following methods for "cleaning" are offered:

For either soil or water-soluble solutions:

(i) Add 1 ounce of activated charcoal and 1 ounce of detergent to each 2 gallons of water. Shake well and discharge through the nozzles, or,

(ii) Add 10 ounces of lye to 2 gallons of water and allow to stand at least 2 hours. Then discharge through the nozzles and rinse the system twice with clean water.

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For water-soluble solutions only:

(iii) Add 1½ ounces of washing soda to each 2 gallons of water and proceed as in (ii).

(iv) Add ½ cup of household ammonia to each 2 gallons of water. Flush some through the nozzles and leave the rest in the tank overnight. Then discharge and thoroughly rinse the system with water.

For oil-soluble formulations only:

(v) Add 1½ cups of kerosene, 1½ ounces of washing soda, and a little detergent to each 2 gallons of water, and proceed as in (ii).

The success of any weed control program is dependent to a very large extent on your knowledge of weeds. Weeds are spread mainly be seeds, hence a major concern must be stopping, or at least limiting, seed production. Growth habit and suseptabilities must be known for each weed species if a spray program is to be effective.

Weeds can be divided into three main categories by their appearance.

1. Grasses: Young grass seedlings have one leaf coming from the seed. Grass leaves are generally narrow, upright and have paralled veins. Many grasses have fibrous root systems.
2. Broadleaf Plants: Broadleaf plants have two seed leaves. They generally have broad net veined leaves and tap roots or coarse fibrous roots.
3. Woody Plants: Woody plants include brush or shrubs which have several stems and are less than 10' tall (as well as trees).

Weeds are also divided by growth cycle.

1. Annuals: Those growing from seed and maturing each year, such as ragweed, pigweed, lamb's quarters, crab grass.

Biennials and Winter Annuals: Those with a two season growth cycle. The seeds germinate in summer or late fall but stay in the rosette stage until the following spring. These will be the first weeds to show in spring and include wild carrot, yellow rocket and Scotch thistle. These weeds mature, produce seeds and die the second year.

Perennials: These continue to grow from a root system. They usually start growing later in the spring than biennials and go dormant after seed set. These plants can live indefinately and can be of several forms including grasses, herbaceous,soft bodied plants and woody shrubs. Examples are dandelion, field bindweed, plantain, milkweed, goldenrod and willow.

The following are several common weeds of lawns. The chemical control of these will be outlined in a later section of the course.

..../2

C2.

QUACK GRASS

Agropyron repens (L.) Beauv. [redacted]

Other names: couch grass, scutch grass, twitch grass.

Perennial, spreads by branching, whitish rhizomes (underground stems) that have many nodes (joints) and hard, white, sharp-pointed tips. Roots are produced from the nodes and some tips turn upward to become new leafy shoots. These leafy shoots grow faster and taller than most lawn grasses and give the lawn a tufted, ragged appearance soon after mowing. At the base of every leaf blade just where it joins the leaf sheath is a very short, white membrane, called a ligule, and a pair of small but prominent, fingerlike hooks, called auricles, which clasp the stem [redacted]. The leaf sheath which surrounds the stem below each leaf blade is split and its edges overlap. The inflorescence (flowering head) is a single spike on each stem with the groups of seeds in two rows, one row on each side of the spike. However, these are rarely seen in mown lawns. The whitish rhizomes with sharp-pointed tips, and the prominent auricles at the base of the leaf blade are important distinguishing features.

CONTROL Quack grass is resistant to 2,4-D and related herbicides and cannot be selectively controlled in lawns by chemical means. Fortunately, it is not able to compete well with a vigorous stand of lawn grasses. Repeated mowing, especially if the mower is not set too low, places a much greater stress on quack grass (normally a fairly tall plant) than it does on most lawn grasses. Over a period of years, quack grass will be crowded out if a good program of turf management is followed.

If a new lawn is planned, care should be taken to eliminate quack grass *before* seeding. This may be done by persistent cultivation or by shaking out the rhizomes with a fork. Two chemicals, amitrole (amino triazole) and dalapon, at 4 oz per 1000 sq ft, have also been found effective. Either of these herbicides should be applied to the quack grass foliage during active growth. The area should be plowed one to two weeks later. Because both materials may render the soil toxic to lawn grasses for some time after treatment, at least six weeks should elapse before the lawn is seeded.

C5

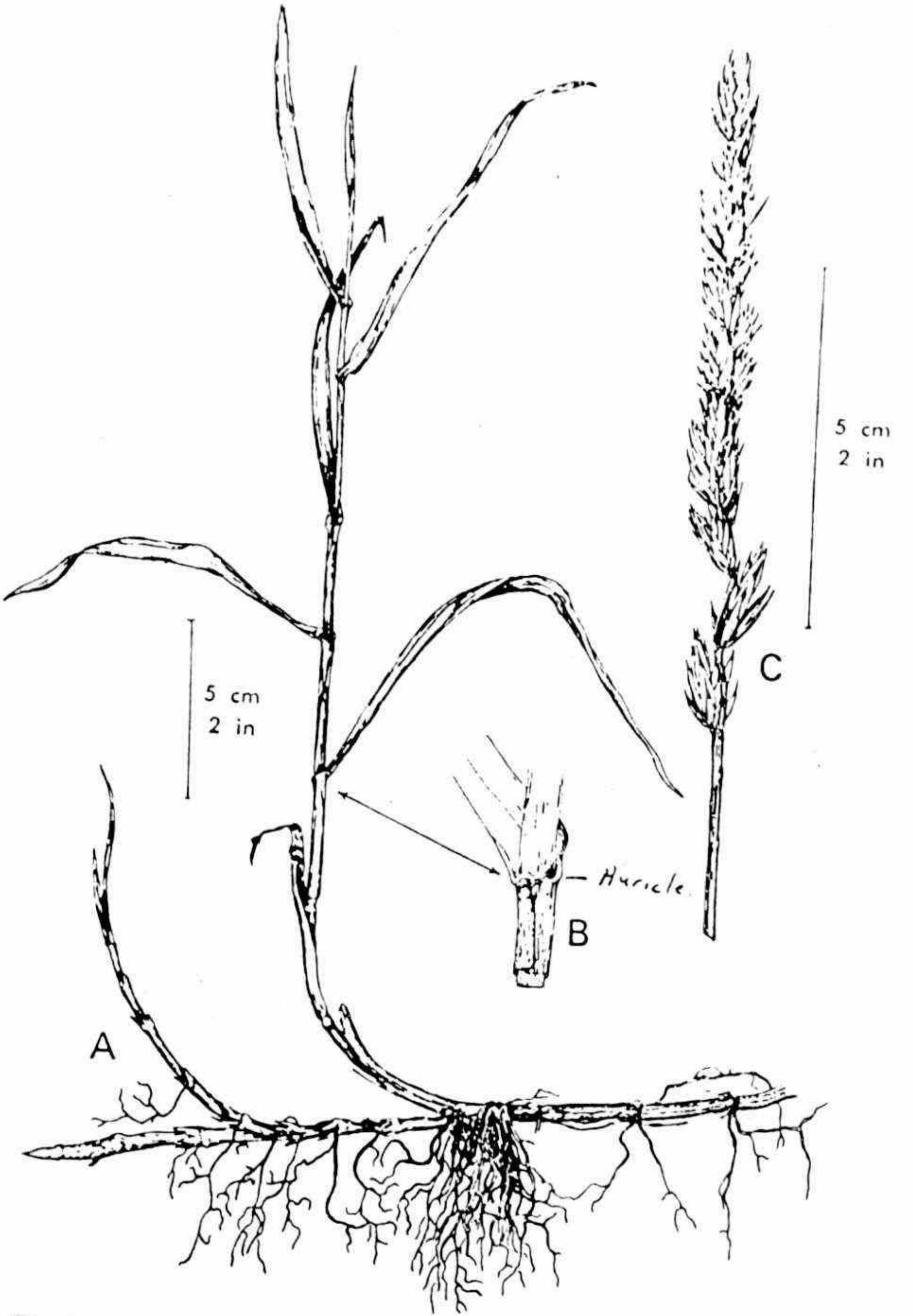

Fig. 1. Quack grass: A. plant with sharp pointed rhizome; B. leaf-base showing 2 auricles; C. seed head.

C4

ANNUAL BLUE GRASS

Poa annua L. ([redacted])

Annual, tufted, with few to several short stems nearly prostrate at their bases but curving upward at their tips. Leaves short, soft, about 1/10 inch wide, with a thin, white, membranous ligule about 1/10 inch long, tight against the stem just at the junction of the leaf blade and leaf sheath ([redacted]). Inflorescence (seed head) light green, short and compact with a central stalk and several side branches, each fine branch ending in a simple spikelet (tight little cluster) of three to six seeds.

Repeated mowings that cut off the ends of the stems cause annual blue grass to branch more and more from near the ground surface. These branches often produce inflorescences that flower and set seed below mowing height, giving the lawn an unsightly appearance and, incidentally, ensuring an ample seed supply for next year!

CONTROL Because annual blue grass can only reproduce from seed and the plants live only one year, the key to control is twofold: (1) prevent established plants from producing seed and (2) prevent the seed already in the soil from germinating and successfully establishing new plants. If there are only a few plants in the lawn they can be loosened with a spud, knife or large screw driver and pulled out by hand. There is no regrowth from root fragments of annual grasses as there is from the underground rhizomes of quack grass or smooth brome ([redacted]. Raking the lawn before mowing tends to lift the branches upright where they are more likely to be cut by the mower blades. Clippings should be raked up carefully to remove all seed heads.

Seedling establishment can be prevented, or at least greatly reduced, by maintaining a dense vigorous turf with proper mowing, fertilizing, watering and disease control ([redacted]). Chemical control of annual blue grass seedlings using the same preemergence chemicals and at the same rates as recommended for crab grass has had some success ([redacted].

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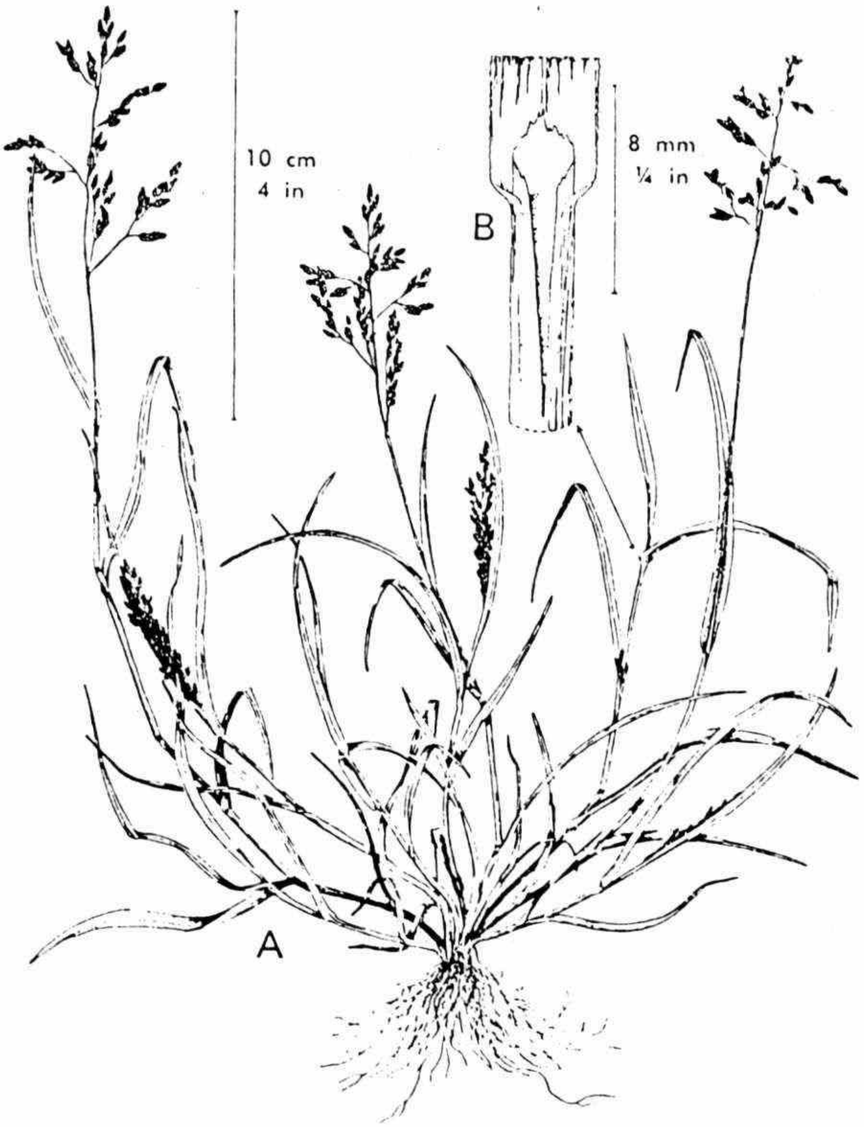


Fig. 2. Annual blue grass: A. plant; B. leaf-base showing ligule.

C6

CRAB GRASS

Digitaria spp. ([redacted])

Two similar kinds of crab grass are found in lawns: **large crab grass** (*D. sanguinalis* (L.) Scop.) and **smooth crab grass** (*D. ischaemum* (Schreb.) Muhl.). Both are annual and reproduce only from seed. Stems lie close to the ground and often root at the nodes. This prostrate feature makes it difficult to cut them with a lawn mower. Leaves are short, somewhat yellow-green when young, may turn purplish with age, and have a whitish, membranous ligule (thin, short bit of tissue) next to the stem at the junction of the leaf sheath and leaf blade ([redacted]). Inflorescence of several thin spikes produced in fingerlike fashion at the end of each stem. Seeds arranged along only one side of the main axis of each spike. **Large crab grass** has distinctly hairy leaves and leaf sheaths ([redacted]), leaf blades 3/16 to 2/5 inch wide, and a greenish brown inflorescence.

Smooth crab grass has no hair on the leaf blades ([redacted]) but may be slightly hairy on the lower leaf sheaths, has leaf blades usually less than 3/16 inch across, and its inflorescence is usually purplish brown.

CONTROL Both kinds of crab grass are found usually where the turf is thin and where there is much sunlight. Cultural measures such as mowing with the mower set to cut high (1 1/2 to 2 inches), adequate water, and the use of fertilizers to improve the turf, will do much to eliminate crab grass.

Certain chemicals will give excellent control of this weed. The most effective are those that are applied before the crab grass seedlings emerge (pre-emergence treatment). In Ontario, emergence of crab grass seedlings generally occurs during the first weeks of May, so treatment should be made in April or very early May.

Late fall (October or November) applications of certain preemergence herbicides also give excellent control of crab grass in lawns. ([redacted].)

Chemicals for the control of crab grass are available in both liquid and granular formulations. The granular materials may be distributed by means of a fertilizer spreader. Most are now also available as mixtures with fertilizer, so the two operations may be carried out at one time. It is advisable to divide the required amount of chemical into two portions and spread one portion at right angles to the other to ensure uniform distribution over the entire lawn area.

[redacted]

[redacted]

[redacted]

C7

~~Siduron (Tupersan) is available as a wettable powder and in mixtures with fertilizer. It may be used on established turf and, unlike the other pre-emergence crab grass herbicides, on newly seeded lawns. Also, bare patches in an established turf may be reseeded immediately after using siduron as it is not toxic to most species of turf (Washington bent grass is susceptible). Application rates of 8 to 12 lb (active) per acre are recommended. Do not use in the fall of the year.~~

~~Terbutol (Azak) is available as a wettable powder or in fertilizer mixtures. Use at 10 lb (active) per acre or 1/4 lb (active) per 1000 sq ft. Use in early spring.~~

> ~~Important — Since the percentage of active chemical differs in the various commercial formulations available, the manufacturers' directions and cautions given on the label must be followed.~~

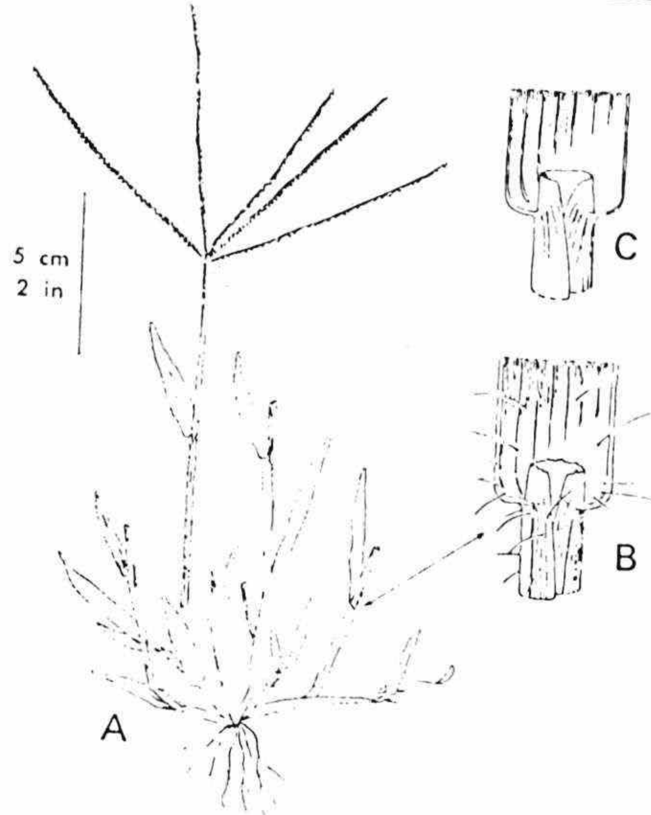


Fig. 3. Crab grass: A. plant of large crab grass; B. leaf-base of large crab grass showing hairs; C. leaf-base of smooth crab grass showing lack of hairs.

C 8

OTHER WEEDY GRASSES

Several weedy grasses, other than the three illustrated and discussed on the previous pages, may also appear in the lawn. These grasses are most easily and accurately identified by distinctive characters in their inflorescences (seed heads). But seed heads are rarely produced in regularly mowed lawns. Line drawings of leafy clumps are of little help in identifying grasses so habit drawings of these individual grasses are not included in this bulletin.

Fortunately, however, most grasses have distinctive "leaf-base" characters, similar to the way that individual people have distinctive fingerprints. The homeowner can see them with the naked eye or ([redacted]) with an inexpensive hand magnifying glass.

The grass leaf has two major parts, the *leaf blade* which sticks out at an angle from the stem, and the *leaf sheath* which is more or less tightly wrapped around the stem and is the connecting part between the leaf blade and the node (joint) farther down the stem ([redacted]. The "leaf-base" characters are found at the junction of leaf blade and leaf sheath. Right next to the stem where the leaf blade joins the sheath is the *ligule*. It may be a very thin, soft, erect membrane of white tissue, or a dense row of short, fine hairs like an eyelash. It is most easily seen by grasping the leaf blade close to the stem and gently pulling the blade and thus also the leaf sheath away from the stem. Nearly all grasses have a ligule of some kind. One or two *auricles* may also be present on some grasses. Auricles are small soft claws or points of tissue which stick out from the uppermost margins of the leaf sheath and clasp the stem on the opposite side from the leaf blade.

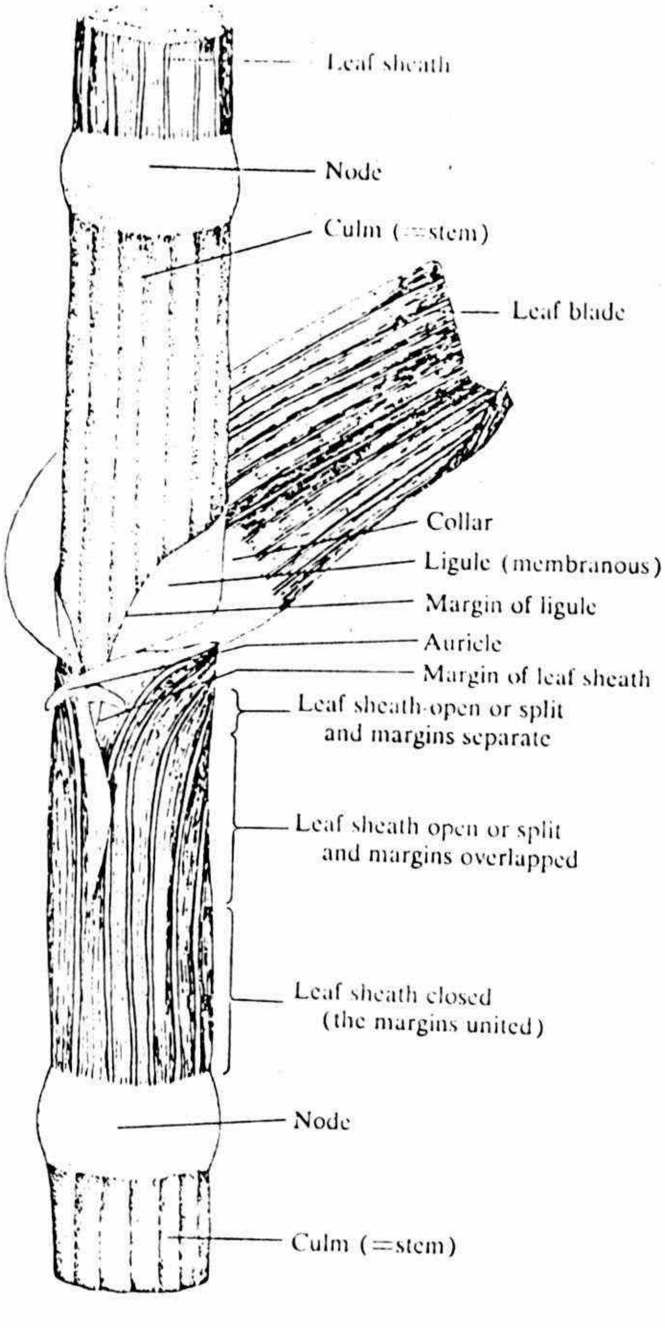

Leaf sheath
Node
Culm (=stem)
Leaf blade
Collar
Ligule (membranous)
Margin of ligule
Auricle
Margin of leaf sheath
Leaf sheath-open or split and margins separate
Leaf sheath open or split and margins overlapped
Leaf sheath closed (the margins united)
Node
Culm (=stem)

Fig. 4. *"Leaf-base" characters of a typical grass*

SMOOTH BROME

Bromus inermis **Leyss.**

Other name: brome grass.

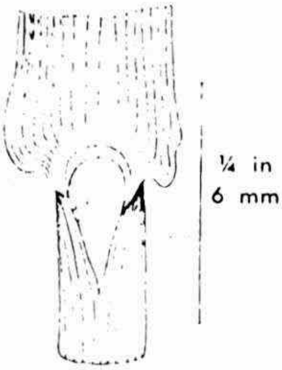


Fig. 5. Smooth brome, leaf-base

Perennial, spreading with branching underground rhizomes. Rhizomes (underground stems rooting at the nodes) resemble those of quack grass ([redacted]) but are brownish, covered with darker brown fibrous sheaths, and usually not sharp pointed. Margins of leaf sheath united, except for a V-shaped notch at the top, and form a cylinder around the stem. Ligule a membrane with rounded margin but very, very short (1/50 inch long). No auricles or sometimes a very short one. Leaf blade and sheath smooth (without hair).

[redacted].

CREEPING BENT GRASS

Agrostis palustris **Huds.**

Other name: carpet-bent

Perennial, forming very dense mats. Reproduces by above-ground leafy stolons that root at every node close to the ground; shallow-rooted. Stolons, stems and leaves very fine and slender. Ligule a prominent membrane, often as long as or longer than the width of the blade. No auricles. Blade and sheath without hair.

[redacted]

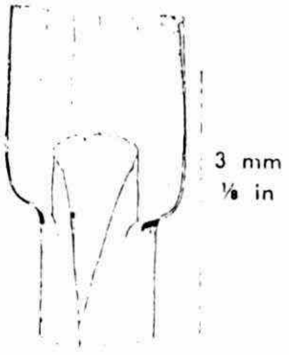


Fig. 6. Creeping bent grass, leaf-base

ORCHARD GRASS

Dactylis glomerata **L.**

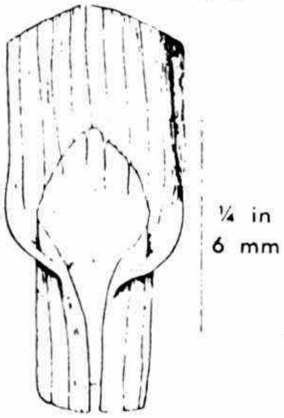


Fig. 7. Orchard grass, leaf-base

Perennial, non-creeping. Stems coarse, erect, elliptical or flattened in cross-section. Leaf sheath pale green to white near bottom. Leaf blade shallowly folded lengthwise. Ligule membranous, 1/12 to 1/3 inch long, flattened across top with a tiny point near the center. No auricles. Blade and sheath without hair.

[redacted].

C 11

TIMOTHY

Phleum pratense L.

Perennial, non-creeping. Base of each leafy stem whitish and thickened or bulbous. Leaf blade flat. Ligule membranous, up to 1/10 inch or longer, broadly pointed at the center, and usually with a distinct notch in the margin part way down on either side. No auricles. Blade and sheath without hair.

[redacted]

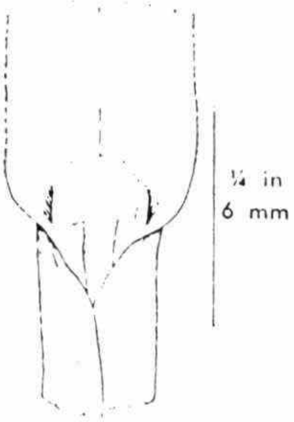


Fig. 8. Timothy, leaf-base

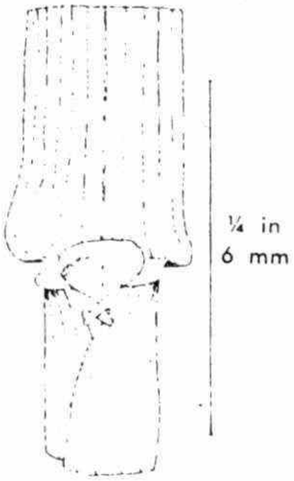


Fig. 9. Meadow fescue, leaf-base

MEADOW FESCUE

Festuca elatior L.

Perennial, loosely tufted or weakly creeping. Stems with a purplish or reddish tinge at the base. Leaf sheath split, with membranous, overlapping margins. Ligule membranous, extremely short. Auricles present, soft, claw-like, yellowish green to creamy white, up to 1/15 inch long. Blade and sheath without hair.

[redacted]

FOXTAIL BARLEY

Hordeum jubatum L.

Other name: wild barley

Perennial, tufted. Stems and leaves fine, with a bluish green cast. Leaf sheath split, paler green or pink-tinted near the base. Ligule membranous, up to 1/25 inch long, nearly blunt. Auricles very short or absent. Leaf blade with fine hairs on upper surface; leaf sheath may be with or without fine hairs.

[redacted]

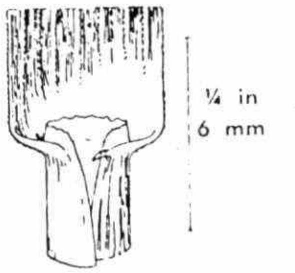
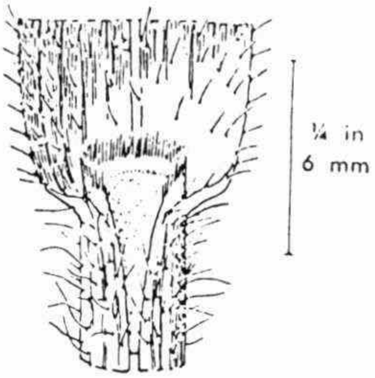


Fig. 10. Foxtail barley, leaf-base

WITCH GRASS

Panicum capillare L.

Other names: old witch, tickle grass.



Annual. Stems erect. Inflorescence bushy branched, very fine. Leaf blades and sheaths very hairy; hairs on leaf sheath firm, almost bristle-like, and pointing nearly straight out from the sheath. Ligule a dense fringe of very short hairs. No auricles.

[redacted]

Fig. 11. Witch grass, leaf-base

BARNYARD GRASS

Echinochloa crusgalli (L.) Beauv.

Other name: water grass.

Annual. Stems coarse, very smooth, either erect or prostrate near the base; either nearly round or obviously much flattened in cross-section, sometimes reddish near the base. Leaf sheath split, the margins overlapping. Blade and sheath without hair, or just a few on the margin at their junction. This is the *only* weedy annual grass that has *neither ligule nor auricles.*

[redacted]

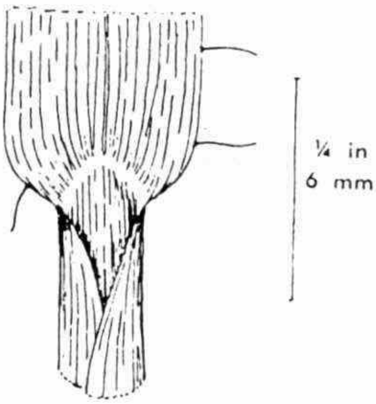


Fig. 12. Barnyard grass, leaf-base

C13

GREEN FOXTAIL

Setaria viridis (L.) Beauv.

Annual. Stems erect or nearly so, mostly round but sometimes flattened in cross section, light green or slightly purplish toward base. Leaf sheath split, margins overlapping; outer margin with a fringe of fine hairs. Ligule a dense fringe of hairs up to 1/12 inch long. No auricles. Leaf blade without hair; the surface of the leaf sheath without hair or with a few very short, fine hairs.

~~**CONTROL.** See pages 7-9, and as for crab grass, page 11~~.

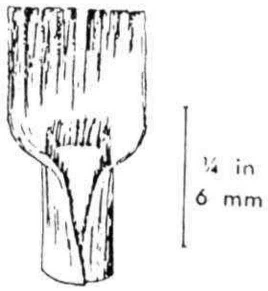


Fig. 13. Green foxtail, leaf-base

YELLOW FOXTAIL

Setaria glauca (L.) Beauv.

Annual. Stems nearly erect, usually distinctly flattened in cross section, often tinged with purple or red toward base. Sheath split, margins may or may not overlap and are membranous without a fringe of hairs. Ligule a fringe of very short hairs, 1/25 inch or less. No auricles. Upper surface of leaf blade just near the stem bearing a dozen or so prominent white, kinky hairs about 1/4 inch or longer, otherwise smooth and hairless; sheath hairless.

~~**CONTROL.** See pages 7-9, and as for crab grass, page 11~~.

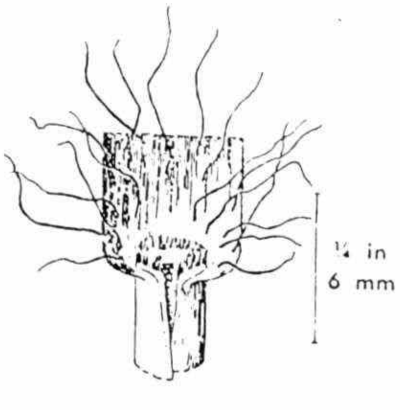


Fig. 14. Yellow foxtail, leaf-base

C 14

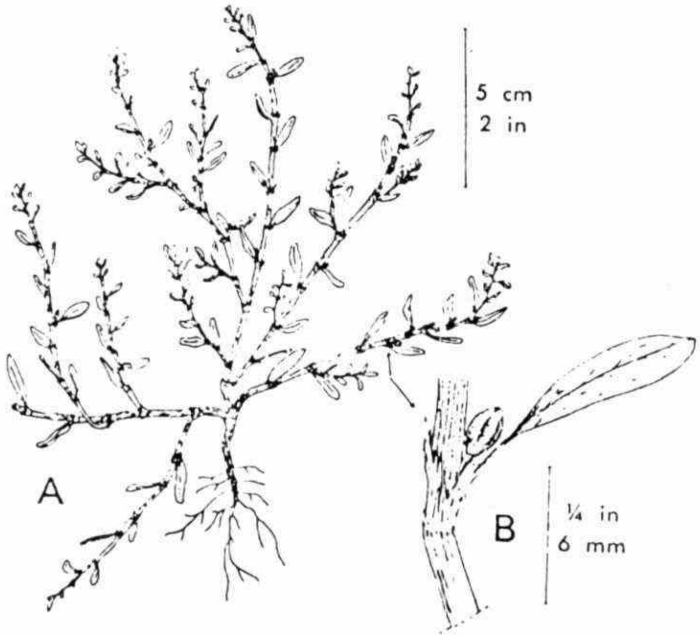
PROSTRATE KNOTWEED

Polygonum aviculare L. (~~Figure 15~~)

Annual with upright to prostrate tough, wiry stems often forming a dense carpet. Leaves small, about 1/3 to 1 1/4 inch long, narrow, smooth margined, without petioles (leaf stalks), but each with a delicate whitish membranous sheath (ochrea) about 1/5 inch long surrounding the stem right at the junction of the leaf blade and stem. Flowers small, white or pinkish, and formed inside these membranous sheaths but soon protrude from them. Fruit single-seeded, hard, dark brown, about 1/10 inch long, triangular.

~~CONTROL~~ Knotweed is a problem chiefly along driveways, pathways, edges of sidewalks, or other areas of thin or compacted soil. It cannot compete with a vigorous stand of grass. The first step is to remove the cause of compaction. Then stimulate and maintain good turf growth. In severely compacted areas, the best remedy may be to dig out the weedy patches and lay new sod or add clean topsoil and reseed.

~~Dicamba is particularly useful for chemical control of knotweed since this plant becomes resistant to other herbicides soon after germination. Use dicamba at 1 oz per 10 gal water per 3500 sq ft, or mixtures containing dicamba and 2,4-D as recommended by the manufacturer. Mixtures of 2,4-D and mecoprop, or 2,4-D and dichlorprop, or 2,4-D and fenoprop will give control only if used when the knotweed is very young (page 9).~~



~~Fig. 15.~~ *Prostrate knotweed: A. plant; B. leaf with ochrea and single-seeded fruit.*

C15

CURLED DOCK

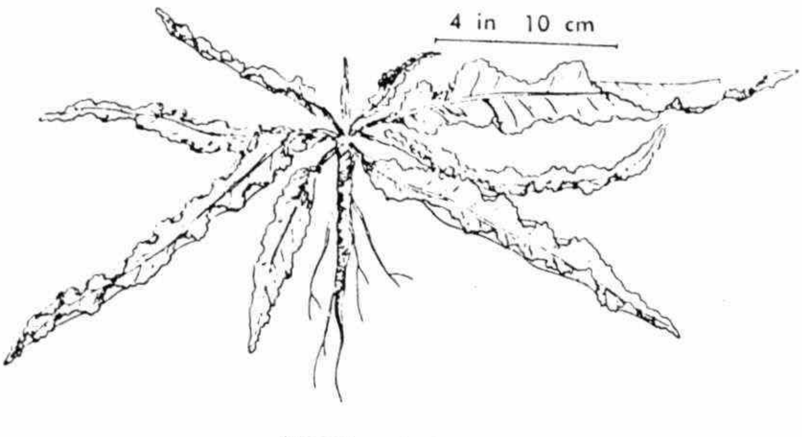
Rumex crispus L. (~~Figure 16~~)

Perennial with a stout taproot, yellowish on the inside. Lower leaves clustered in a rosette around the top of the taproot, dark green, coarse, elongated as much as 12 inches long, tapering to base and tip, and wavy or curly margined (like a green crepe-paper streamer). In lawns it seldom gets past this stage. If not mowed the stem will grow about three feet tall, have similar wavy margined leaves, and produce many small flowers in a dense green inflorescence that gets thicker and turns dark brown at maturity.

Broad-leaved dock (*Rumex obtusifolius* L.) is closely related and similar to curled dock, having shorter and broader leaves that are not tapered at the bottom.

Both of these weeds are rare in well-established and well-kept lawns but they are sometimes a problem in new lawns.

CONTROL Digging or cutting out, unless the entire taproot is removed, may give only temporary control because, like dandelion, pieces of the taproot that remain can sprout and produce new shoots. ~~Chemical control is feasible with 2,4-D. Application should be made early in the spring soon after the rosette appears. Repeat applications may be necessary (page 9).~~



~~Fig. 16~~. *Curled dock*

C/16

THYME-LEAVED SANDWORT

Arenaria serpyllifolia L. (~~Figure 17~~)

Annual. Stems bushy, erect, or reclining and three to four inches tall, covered with very fine, short hairs that give the stems a slightly rough feel and a bluish or gray-green colour. Leaves very small, oval but pointed at the tip, sessile (without a leaf-stalk, the base of the leaf-blade attached directly to the stem) and opposite (two leaves at the same node or joint but on opposite sides of the stem). Flowers small, white, at the ends of the branches and the plant may produce flowers all summer.

~~**CONTROL**~~ H~~erbicide mixtures containing 2,4-D will give good contr~~ol (~~page 0~~).

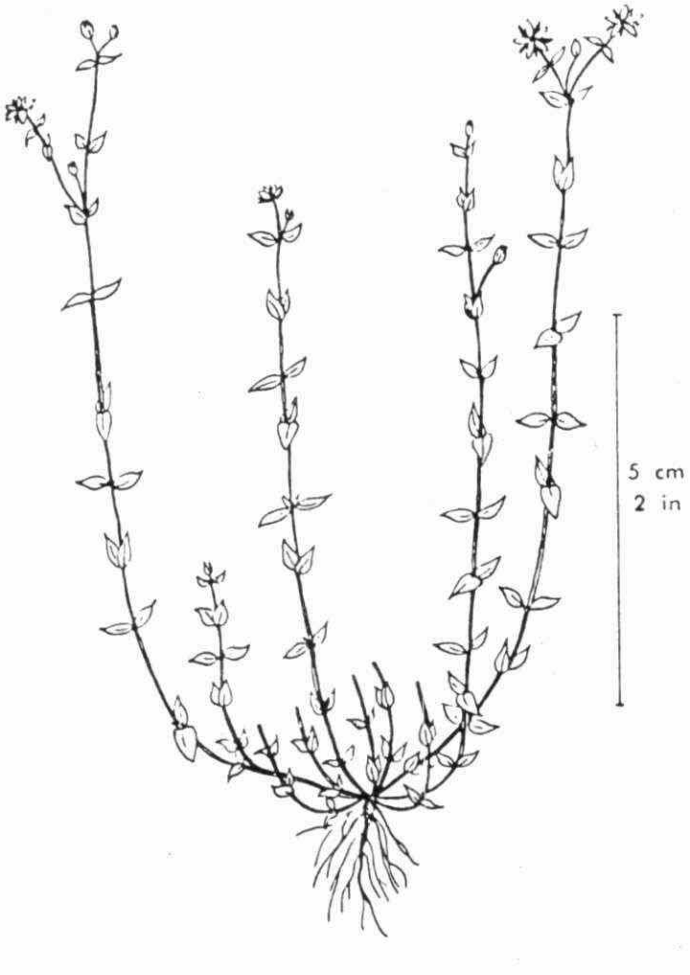


Fig. 17. Thyme-leaved sandwort

C17

BIRD'S-EYE PEARLWORT

Sagina procumbens L. (~~Figure 18~~)

Annual or perennial with very fine, much-branched stems, some lying prostrate and rooting from lowermost nodes, others partly upright. Leaves almost grasslike in shape, color and position, being short (1/4 to 3/4 inch long), flat, very narrow and softly pointed at the tip, and in a dense rosette (cluster) at the center of the plant with smaller rosettes on some of the branches. But unlike the grasses, pearlwort leaves are arranged in pairs on opposite sides at each node (joint) on the stem; the pair of leaves being united by their lowermost edges to form a tiny cuplike sheath around the stem. Tiny white flowers are raised on short erect stalks and are followed by equally small seed capsules containing many extremely fine seeds.

~~**CONTROL** Mecoprop, fenoprop or dicamba used alone or in mixture with 2,4-D will usually give satisfactory control (page 9). Retreatment may be necessary. Use only mecoprop if the weed is growing in bent grass. Watch for new plants from seed for several years afterwards.~~

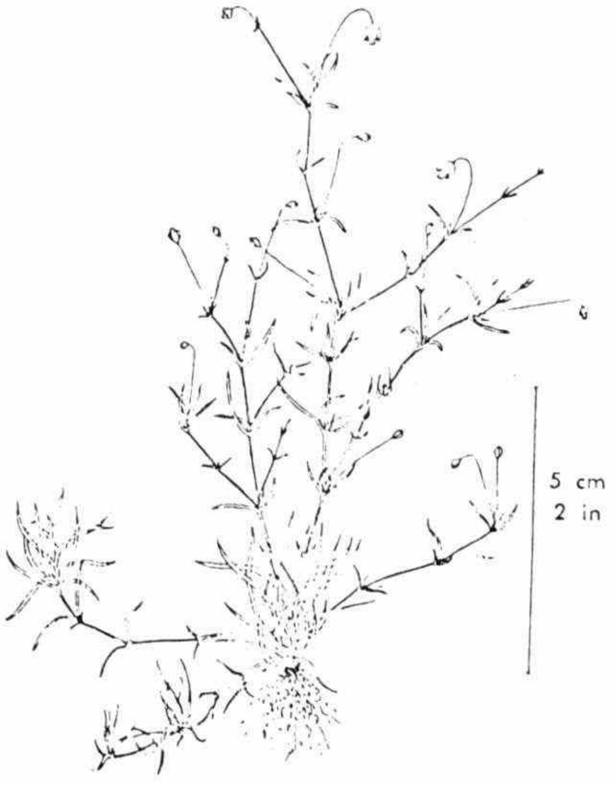


Fig. 18. Bird's-eye pearlwort

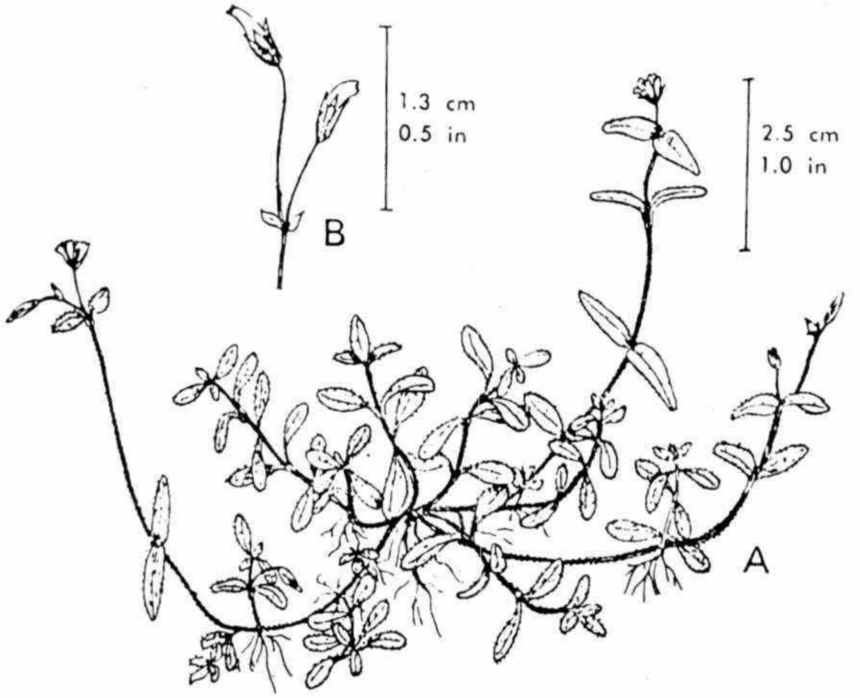
C/18

MOUSE-EARED CHICKWEED

Cerastium vulgatum **L.** ([redacted])

Annual or perennial. Stems dark green, hairy all around, either prostrate or with erect tips and branches, producing roots wherever the nodes touch the ground and the plants spread by this means to form dense patches in the lawn. Leaves opposite (2 at each node), sessile (without leaf-stalks), elliptical or club-shaped and covered with glandular hairs. Flowers have five, deeply-notched, white petals about as long as the sepals. The fruit (seed-pods) are longer than the sepals and are rather curved at the tip.

CONTROL [redacted]



[redacted] *Mouse-eared chickweed: A. plant; B. seed capsules.*

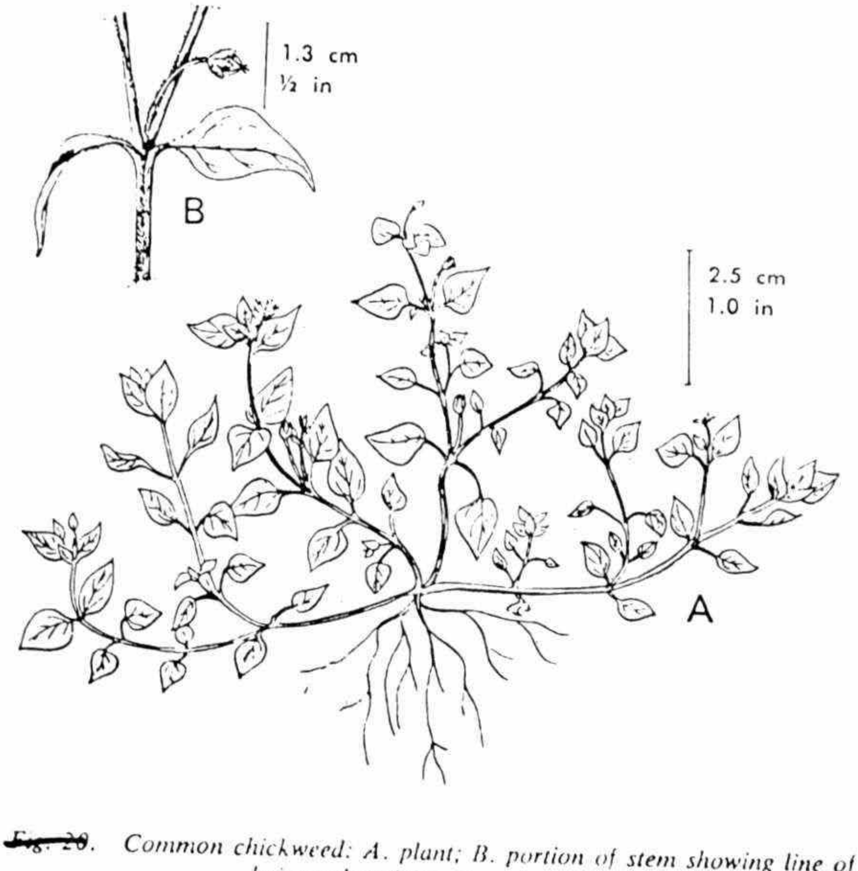
C 19

COMMON CHICKWEED

Stellaria media (L.) Vill. (~~Figure 20~~)

Annual, winter annual, or perennial. Stems bright green, delicate, much branched, mostly smooth but with a single narrow band of fine white hairs running lengthwise up one side of each branch, prostrate or partly erect, and producing roots wherever the nodes touch the ground; the plant spreading by this means and forming densely matted patches. Leaves opposite (two at each node), oval, pointed at the tips, mostly smooth or only slightly hairy. Lower leaves stalked but upper ones usually sessile (without a leaf-stalk). Flowers small, white; each petal two-lobed. It may start blooming in the early spring and produce flowers and seeds all through the growing season.

~~CONTROL~~ Common chickweed is not as difficult to control as mouse-eared chickweed. [redacted]



~~Fig. 20~~. *Common chickweed: A. plant; B. portion of stem showing line of hairs and position of seed capsule.*

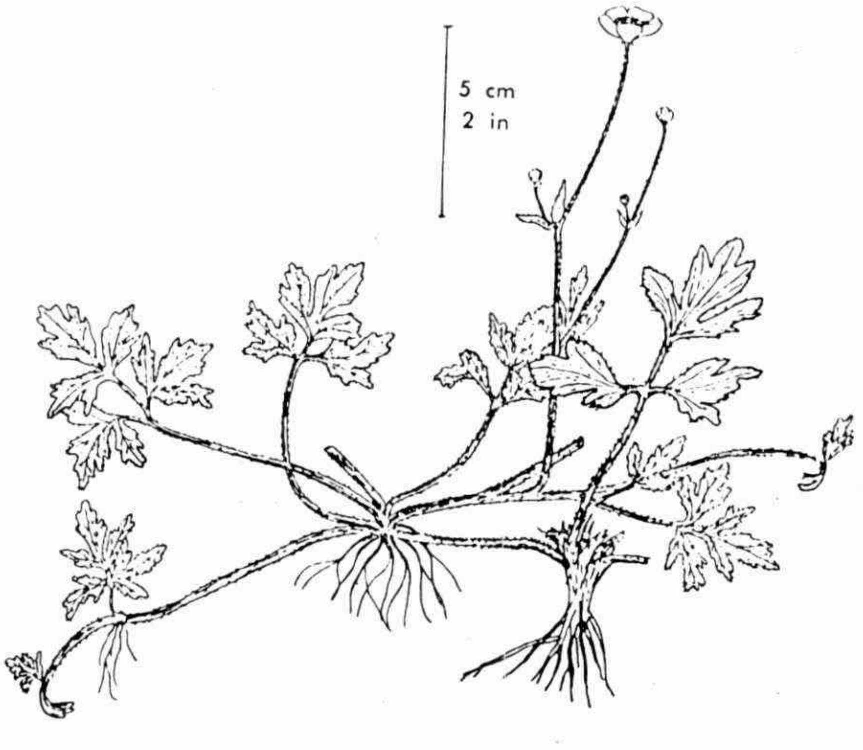
C20

CREEPING BUTTERCUP

Ranunculus repens L. (~~Figure 21~~)

Perennial with fibrous roots. Stems prostrate, somewhat hairy, trailing along the ground and rooting at the nodes and with nearly erect, flowering branches. Leaves dark green with hairy leaf stalks; the leaf blades deeply three-parted, the one terminal or central part (segment) with a thin stalk, the two lateral parts (segments) without distinct stalks, and each of the three parts again more or less deeply lobed and the lobes irregularly toothed. Flowers on long, leafless stalks, with small green sepals, five to nine large yellow petals and many stamens. "Seeds" (actually small, individual fruits) in rounded groups produced from the centre of each flower; each "seed" about an eighth of an inch long, flattened, oval in outline with a strong point at the upper end.

~~**CONTROL** Buttercup may be controlled with 2,4-D when young, but a more satisfactory control is given by the closely related chemical MCPA. Use at 1 oz. per 4 gal of water per 2500 sq ft. The 2,4-D mixtures also are satisfactory. Retreatment is often necessary (page 9)~~.



~~Fig. 21~~. *Creeping buttercup*

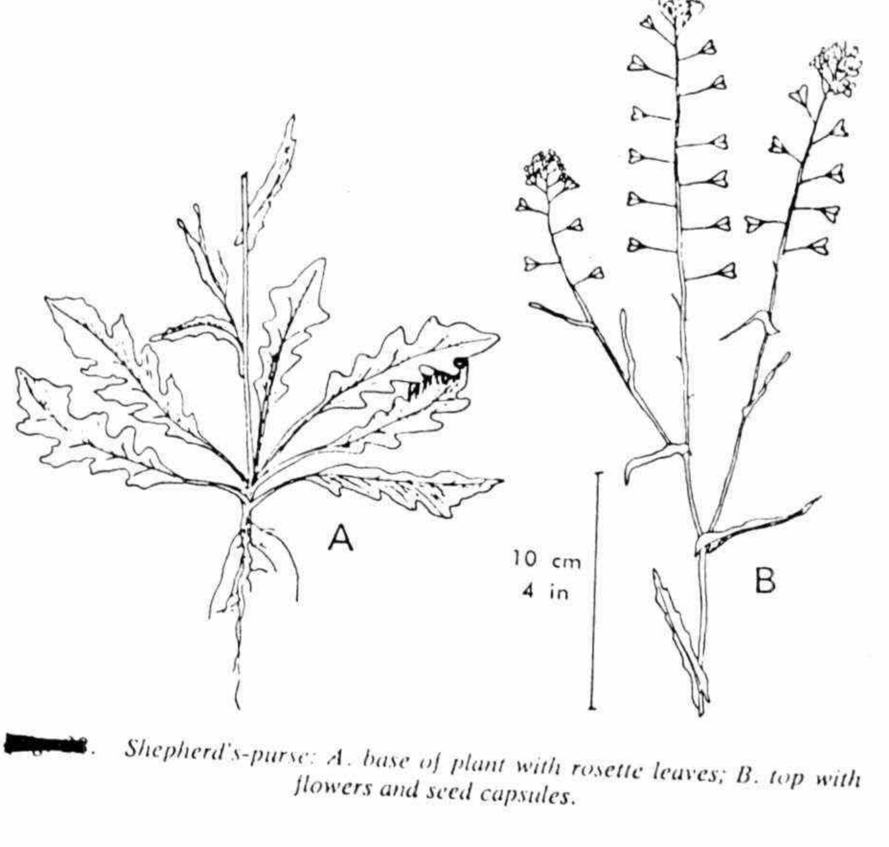
C 21

SHEPHERD'S-PURSE

Capsella bursa-pastoris (L.) Medic. ([redacted])

Annual or winter annual, with a taproot and a rosette of leaves lying flat on the ground during the early stages of growth. Leaves elongated, tapering at both ends and deeply lobed. A slender, few-leaved, flowering stem arises from the center of the rosette and produces many small, white flowers, each with four petals. The seedpods are small, flattened, heart-shaped, and attached to the slender supporting stalk by the pointed end.

[redacted]



[redacted]. *Shepherd's-purse: A. base of plant with rosette leaves; B. top with flowers and seed capsules.*

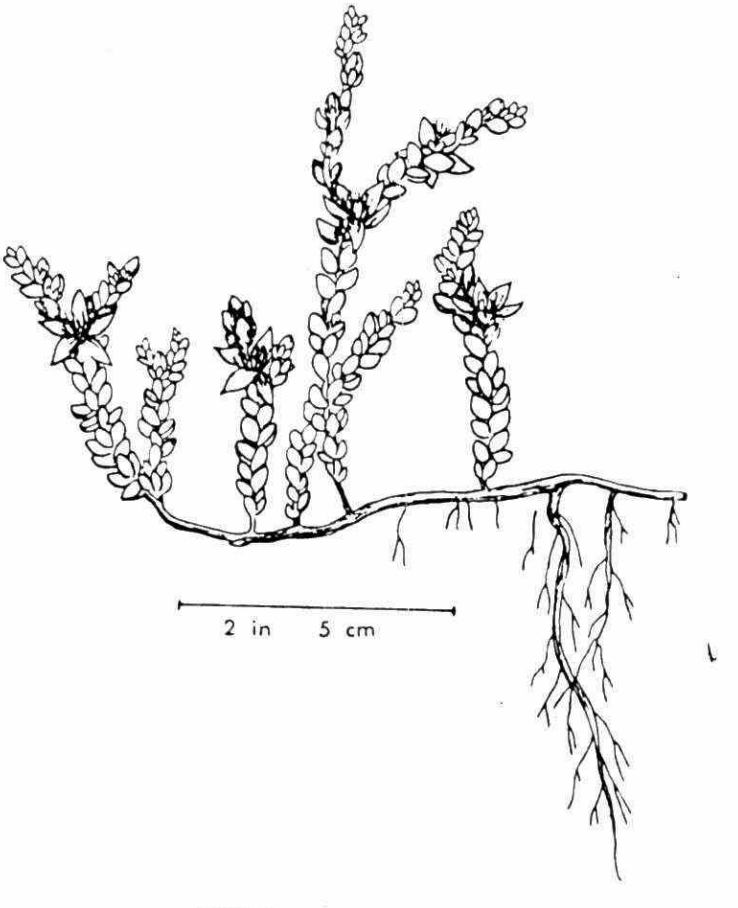
C22

MOSSY STONECROP

Sedum acre L. ([redacted])

Perennial, with densely-matted, tough, creeping stems that frequently root wherever they touch the ground, and erect branches. Stems covered with small (1/4 to 1/2 inch long), overlapping, thick, fleshy, succulent, yellowish green leaves. Flowers about 1/2 inch in diameter with five yellow petals. It is a bad lawn weed in some localities, especially on shallow or light-textured soils.

~~CONTR~~OL The fleshy nature of this plant and its smooth leaves make chemical control difficult. The addition of a surfactant or wetting agent (such as a small amount of soap) [redacted]pplication should be made early in the spring. [redacted]).



[redacted] 23. *Mossy stonecrop*

C 23

SILVERY CINQUEFOIL

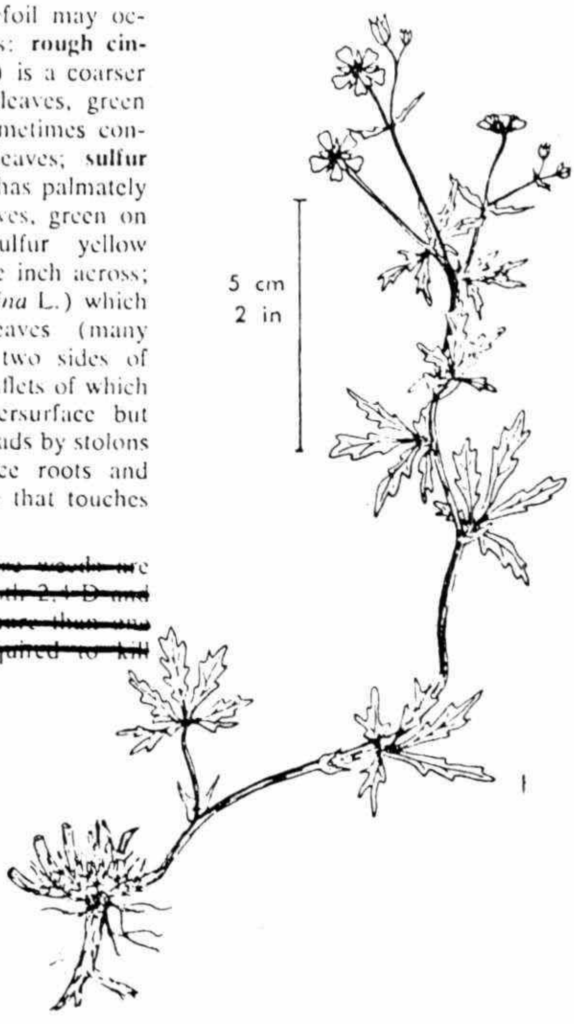
Potentilla argentea L. ([redacted])

Other name: five fingers

Perennial, non-creeping taproot; stems at first nearly prostrate but turn upward at flowering time, often reddish in colour but mostly covered with fine white hairs. Leaves short stalked, palmately three- or five-parted; each part dark green on top, densely white-woolly on the undersurface. Flowers small, about 1/3 inch diameter, yellow, and clustered among leaves at the ends of branches.

Other kinds of cinquefoil may occasionally occur in lawns: **rough cinquefoil** (*P. norvegica* L.) is a coarser plant with three-parted leaves, green on both surfaces and sometimes confused with strawberry leaves; **sulfur cinquefoil** (*P. recta* L.) has palmately five- to seven-parted leaves, green on both surfaces, and sulfur yellow flowers about 3/4 to one inch across; and **silverweed** (*P. anserina* L.) which has pinnately-parted leaves (many leaflets arranged along two sides of the central stalk), the leaflets of which are silvery on the undersurface but usually green above; spreads by stolons (runners) which produce roots and new plants at each node that touches the ground.

[redacted].



[redacted]. *Silvery cinquefoil*

C24

BLACK MEDICK

Medicago lupulina **L.** (~~Figure 25~~)

Other name: yellow trefoil

Annual with thin, wiry stems that trail along the ground, and a thin taproot that is very difficult to pull up. Leaves short stalked and divided into three leaflets resembling a clover leaf, each leaflet being rounded, its margins toothed beyond the middle and ending in a sharp-pointed tip. Flowers yellow, very small, individually resembling those of peas or beans, clustered together in globular flowering heads about 1/3 inch across. Seed pods one-seeded, smooth or hairy, slightly coiled or kidney-shaped, prominently ridged, at first green but turning black when ripe.

~~**CONTROL.** Black medick is difficult to kill with 2,4-D except when very young, but is readily controlled with mecoprop, fenoprop or dicamba. The usual 2,4-D mixtures (page 9) work well when applied during periods of rapid growth~~.

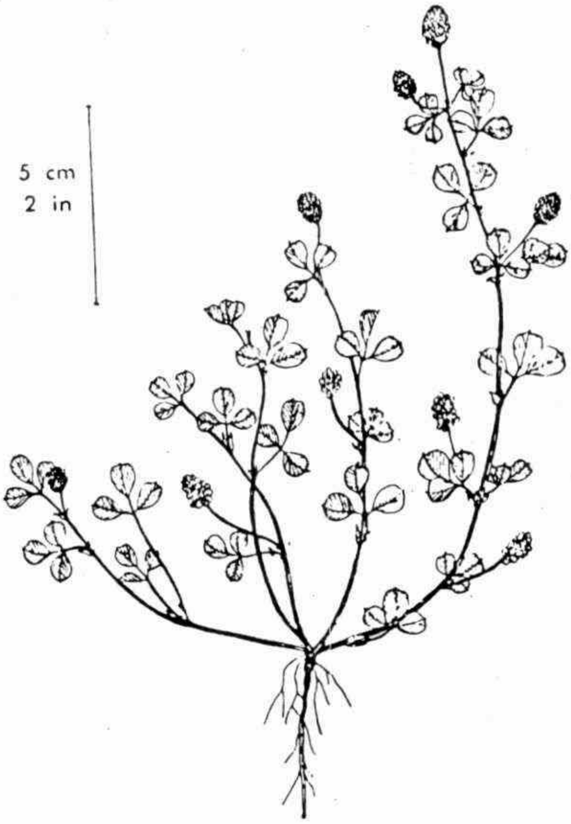


Fig. 25. Black medick

C 25

MALLOW

Malva spp. (~~Figure 26~~)

Two very similar species of mallow occur in lawns: **common mallow** (*M. neglecta* Wallr.) and **round-leaved mallow** (*M. pusilla* Sm.) Both may be annual, biennial or short-lived perennial, have taproots and nearly prostrate stems. Leaves are long-stalked, rounded with a deeply-indented base and irregular margins. Their white, slightly pinkish or bluish flowers have a prominent central cluster of stamens recembling a tiny flower of the single hollyhock or hibiscus. The fruit, developing after the petals fall, is a circle of dry, single-seeded segments arranged around a common center like the sections of a peeled orange. **Common mallow** has petals about 1/2 inch long and fruits with a hairy, non-wrinkled surface (Figure 26B). **Round-leaved mallow** has shorter petals, about 1/4 inch long, and fruits with a wrinkled, non-hairy surface (Figure 26C).

CONTROL Both of these weeds are difficult to control once they have become established. ~~Two or more applications of one of the 2,4-D mixtures (see page 9) will be required to keep them in check~~. Good lawn management is particularly important with these hard-to-control weeds.

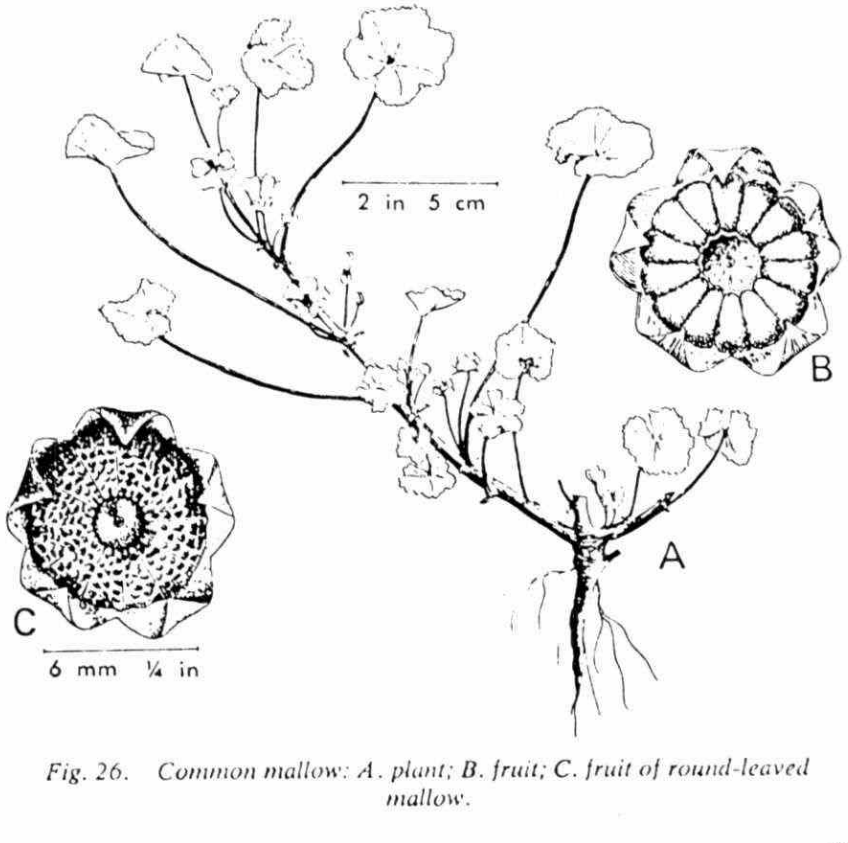


Fig. 26. Common mallow: A. plant; B. fruit; C. fruit of round-leaved mallow.

C26

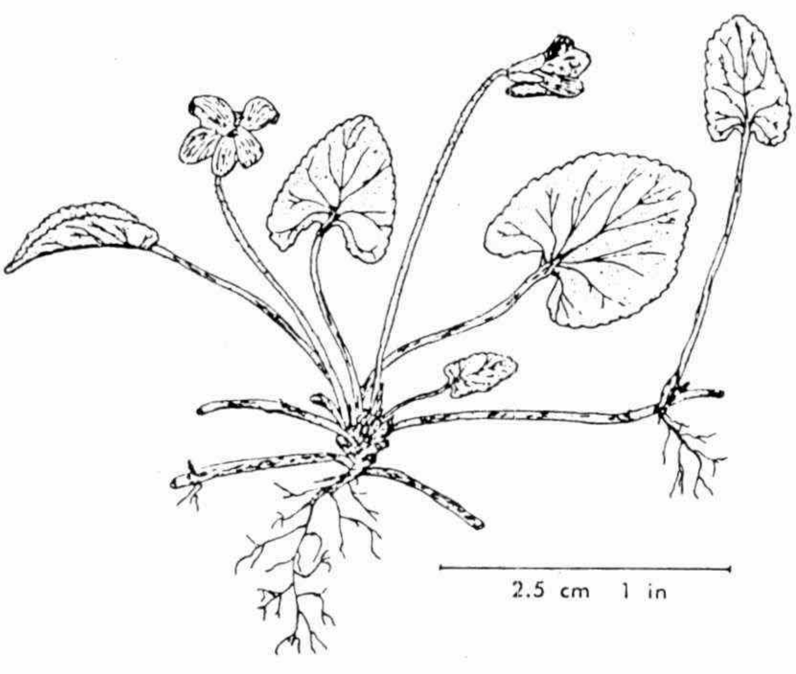
SWEET VIOLET

Viola odorata **L.** (~~Figure~~ 27)

Perennial, with stemless base producing several basal leaves and long prostrate stolons (runners) that root and develop new shoots at nodes and tip. Leaves rounded, heart-shaped to kidney-shaped, one to two inches across, covered with very fine hair; the margins with rounded teeth. Flowering stalks arise directly from the base, as long as or longer than the leaves, with small bracts near the middle; flowers deep violet, occasionally rose or white, very fragrant, about 3/4 inch across, and with a short, straight, blunt spur.

Several horticultural forms of sweet violet, varying in shape, size and color, are grown in perennial beds or borders. Some of these can spread into adjacent lawns where they may become very persistent and choke out the grass.

~~**CONTROL**~~ If there are only a few clumps or single plants, the simplest method is to dig them out. Remove a few inches of surrounding turf with each clump to ensure removal of all reproductive parts of the violet, and replace with clean turf. ~~If digging out is impractical, repeated applicatio~~ns ~~of herbicide mixtures (page 9) will ultimately eliminate sweet viole~~t. This plant does well in shade, hence reduction of shading may also help in its control. (~~See discussion under Moss, page 6~~.)



~~Fig. 27~~. *Sweet violet*

C27

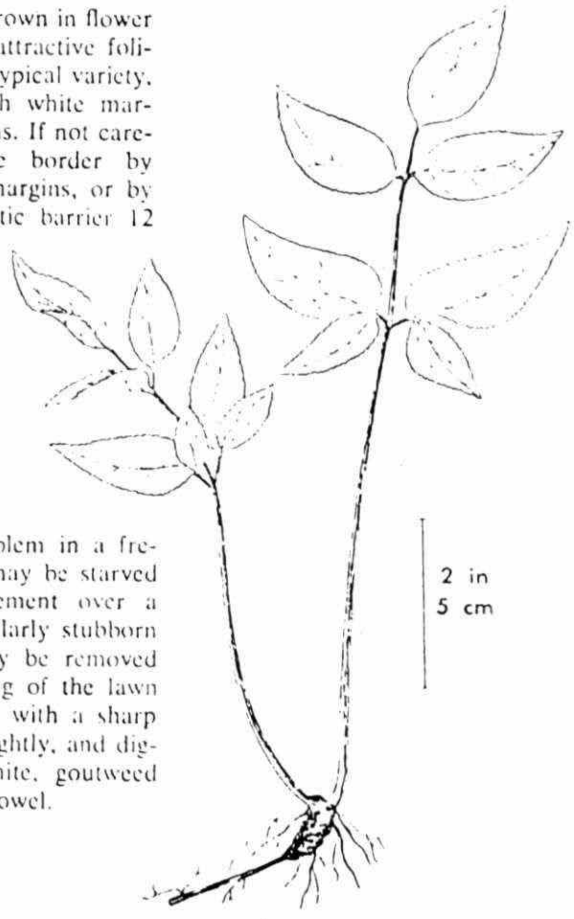
GOUTWEED

Aegopodium podagraria L. (~~Figure 28~~)

Perennial, extremely persistent from white, fleshy underground rhizomes and thickened storage tubers. Leaves mostly basal, arising on long stalks (petioles) from underground rhizomes; the leaf blade compounds into three main divisions, one terminal and two lateral; the one terminal division divided again into three more or less uniform leaflets with toothed margins, and the two lateral divisions each divided again into two or three parts that are unequal in size. Flowering stems are rarely seen in mowed lawns, but where not mowed they may reach 3 ft in height. Lower stem leaves are similar to the basal ones described above; upper leaves smaller and divided once only into three uniform leaflets. Flowers white, clustered in an umbel and resembling those of wild carrot (Queen-Anne's-lace).

Goutweed is usually grown in flower beds or borders for its attractive foliage, bright green in the typical variety, or variegated green with white margins in horticultural forms. If not carefully contained in the border by regular digging at the margins, or by sinking a metal or plastic barrier 12 to 18 inches deep, the horizontal rhizomes of both kinds of goutweed are likely to spread into adjacent lawns.

~~CONTROL~~ Goutweed cannot be controlled selectively by chemicals. However, it is usually not a problem in a frequently-cut lawn, and may be starved by good lawn management over a period of years. Particularly stubborn tubers or rhizomes may be removed after a thorough soaking of the lawn by cutting into the turf with a sharp blade, lifting the turf slightly, and digging out the thick, white, goutweed pieces with a fork or trowel.



F~~ig. 28~~ *Goutweed*

C-28

FIELD BINDWEED

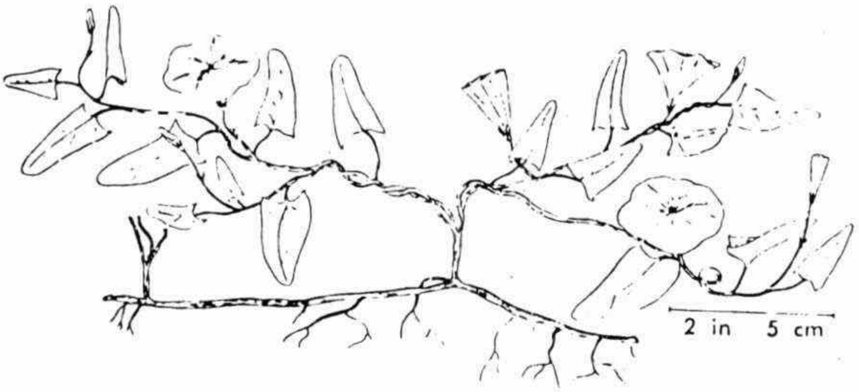
Convolvulus arvensis L. ([redacted])

Other name: wild morning glory

Perennial, spreads both by seed and by producing new shoots from its extensive root system. Main roots white, slightly fleshy, and cordlike. Stems thin, lie prostrate on the ground, or wind around and climb over other plants (hence their common name). Leaves arrow-shaped, light green when young, blue-green when older. Flowers white or pink, trumpet-shaped, about 1 inch across, resembling the cultivated morning glory. Fruit a round capsule with three or four seeds.

[redacted]s. As with other deep-rooted perennials, good lawn management is a major factor in its control.

Wild buckwheat (*Polygonum convolvulus* L.) resembles field bindweed but is annual; has a simple, noncreeping taproot; leaves broader at the base and sharper at the tip; small clusters of tiny, greenish white flowers followed by black triangular seeds at the junctions where the leaf stalks meet the stem. It is sometimes a problem in new lawns or on old lawns after scattering wild bird seed or topdressing with soil or manure. [redacted]



[redacted] *Field bindweed*

C-29

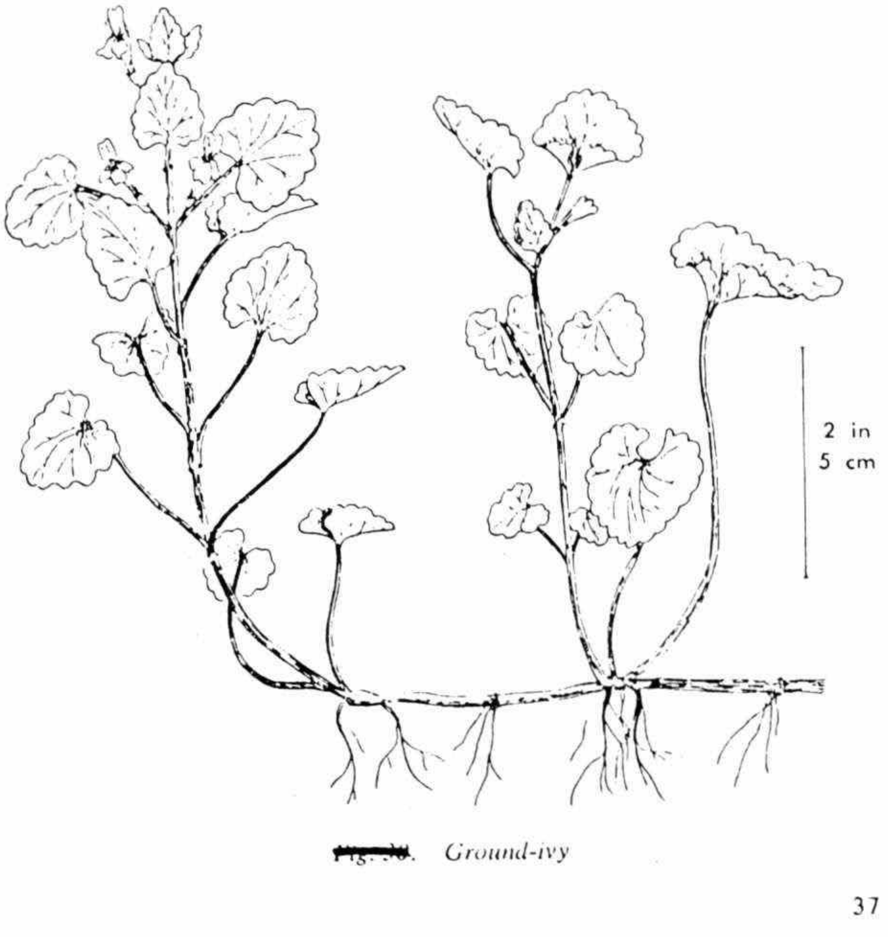
GROUND-IVY

Glechoma hederacea L. [redacted]

Other names: creeping Charley, Gill-over-the-ground

Perennial with creeping, prostrate, square stems, that root at every node which touches the ground, and short, erect leafy branches. Leaves opposite (in pairs at each node on the stem), long stalked, rounded to kidney-shaped blades, coarsely round or wavy toothed, and green to sometimes purplish green. Flowers in axils of leaves (in the angle between leaf stalk and stem) on the erect branches, blue-violet, irregular in shape, and less than 1 inch long. The plant has a strong, disagreeable, almost rancid, mint-like odor. This odor, the stalked, rounded leaves, and the creeping square stems are good distinguishing characters of ground-ivy.

[redacted]L One of the commonest lawn weeds, [redacted].



[redacted]. *Ground-ivy*

C30

HEAL-ALL

Prunella vulgaris L. (~~Figure~~ 31)

Other name: Self-heal

Perennial. Although normally a nearly erect plant, when repeatedly mowed or trampled as in a lawn it becomes densely matted with creeping stems rooting from the nodes. Leaves in opposite pairs, short stalked, small, elliptical or oval, with nearly smooth margins. Flowers blue-violet (rarely pink or white), of irregular shape, in headlike clusters at the ends of the stems or branches. The plants form compact patches in the lawn and may never reach the flowering stage where the lawn is kept well mowed. The creeping stems with opposite, oval leaves and faint but rather unpleasant mint-like odor are good distinguishing characters for heal-all.

CONTROL ~~Like mouse-eared chickweed and black medick, this weed~~ is ~~resistant to 2,4-D. However, it may be controlled readily by treatment with the 2,4-D mixtures, especially those containing mecoprop or fenoprop~~ (~~page 9~~).

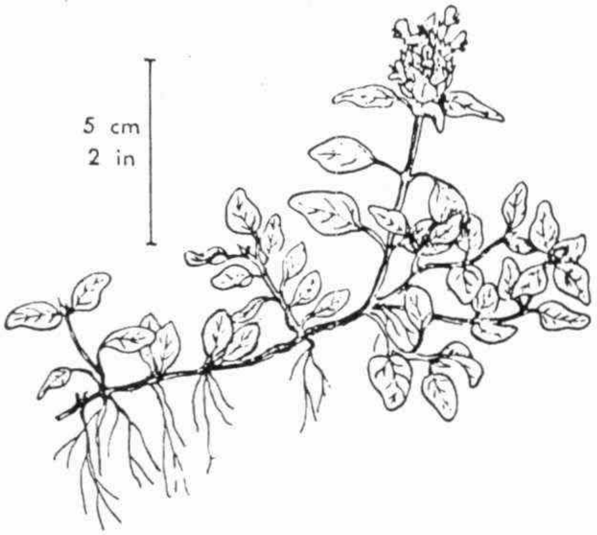


Fig. 31. Heal-all

C 31

SPEEDWELLS

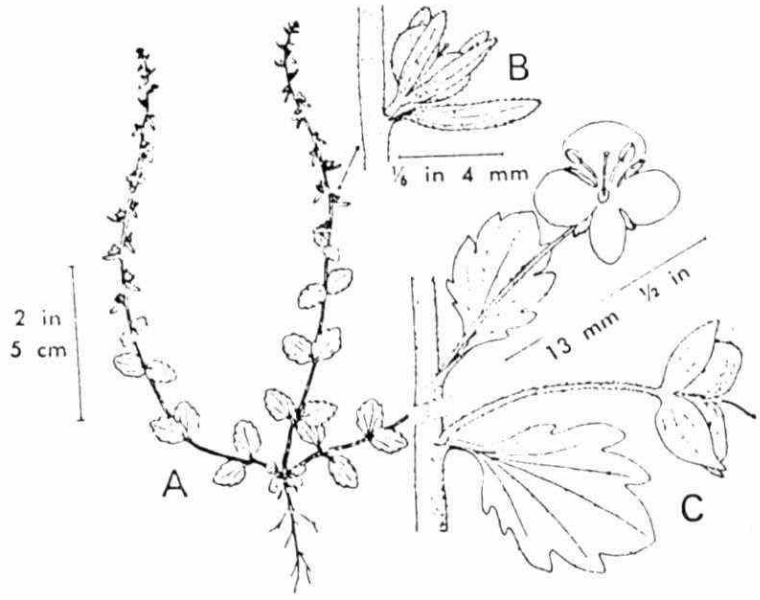
Veronica spp.

Several kinds of speedwells are weedy in lawns. Some are annual and reproduce only from seed; others are perennial and reproduce both from seed and from creeping stems and rhizomes. The most common kinds in Ontario are described here.

CORN SPEEDWELL

Veronica arvensis **L.** (~~Figure 32~~)

Annual with a taproot. Stems erect, or spreading from the base and becoming erect, somewhat hairy. Lower and middle leaves opposite in pairs, the lowermost pairs with short stalks but the middle ones stalkless; all leaves ovate or elliptic, palmately veined (with two or more main veins fanning out from the leaf stalk), hairy on both surfaces, and with slightly rounded teeth on the margins. Upper leaves alternate (only one at each node on the stem), smaller, narrower, without teeth. Inflorescence a spike, flowers sessile (with very short stalk and lying snugly in the angle between leaf and stem), blue-violet, about 1/10 inch across, with four lobes and two tiny stamens. Seed capsules rounded-heart-shaped with a distinct notch at the top and the short style remaining erect in that notch (~~Figure 32B~~).



~~Fig. 32.~~ *Corn speedwell: A. plant; B. seed capsule on very short stalk; C. long-stalked seed capsule and flower of bird's-eye speedwell.*

C32

Bird's-eye speedwell (*Veronica persica* Poir.) is an annual with blue flowers and its lower and middle stem leaves similar to corn speedwell. It differs by having upper leaves that are broader and toothed, flower stalks 1/2 to 3/4 inch long, and seed capsules that are much broader than long (Figure 32C).

Creeping speedwell (*Veronica filiformis* Sm.) has leaves, flowers and seed capsules similar to bird's-eye speedwell but it is a perennial from thin underground rhizomes and has fine, slender, trailing stems that root at the nodes.

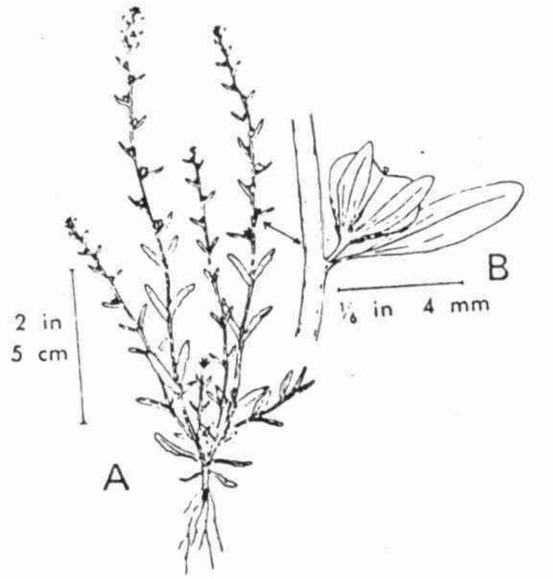
CONTROL ~~Mixtures of 2,4-D with mecoprop and/or dicamba (page 9~~). ~~Repeat applications are often necessar~~y.

PURSLANE SPEEDWELL

Veronica peregrina L. (~~Figure 33~~)

Annual. Stems erect or much-branched near the base and becoming erect, smooth or with fine, slightly sticky hairs; stem and leaves with a fleshy appearance. Lower and middle leaves opposite in pairs, oblong or spatulate, lower ones with a short petiole (stalk), middle and upper ones sessile (with no stalk); upper leaves smaller, narrower, alternate (one at each node on the stem). Inflorescence a thin spike at the end of each stem. Flowers white, very small; one flower on a very short stalk in the angle between each small upper leaf and the stem. Seed capsules somewhat flattened, heart-shaped with a distinct notch in the top end, and the tiny style remaining in that notch (Figure 33B).

~~**CONTROL** Mixtures of 2,4-D with mecoprop and/or dicamba (page 9~~).



~~Fig. 33.~~ *Purslane speedwell: A. plant; B. seed capsule on very short stalk.*

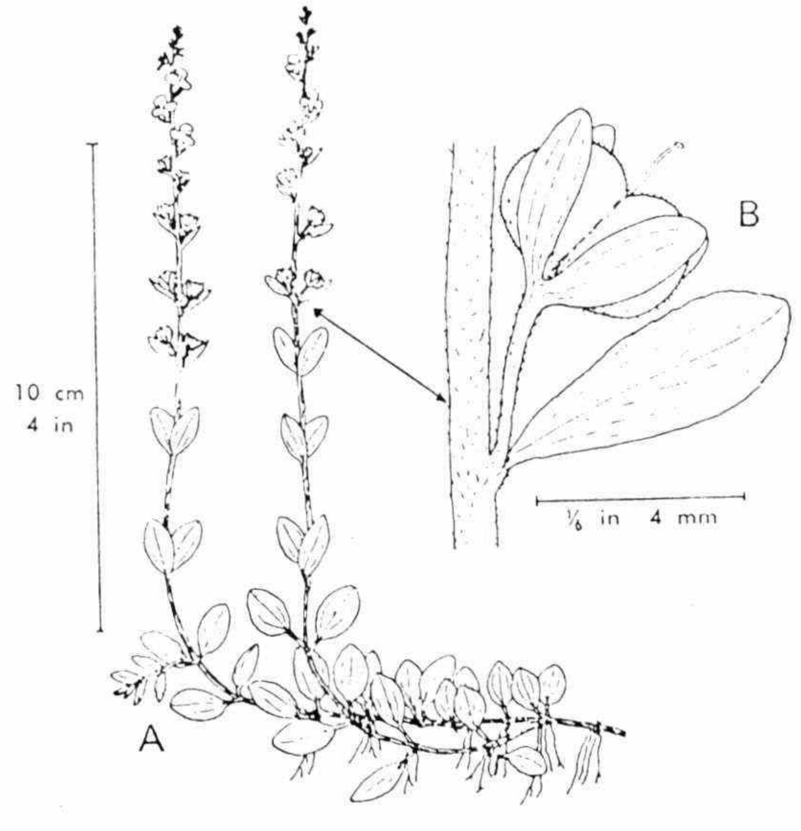
C33

THYME-LEAVED SPEEDWELL

Veronica serpyllifolia L. ([redacted]

Perennial, forming compact patches in the lawn from branching underground rhizomes. Stems creeping at the base and rooting from the nodes, with lower branches prostrate, then turning erect, smooth or very finely hairy. Lower and middle leaves opposite in pairs, elliptic or broadly ovate; lower ones with a short stalk; middle and upper ones without stalks; upper leaves gradually smaller, narrower and arranged alternate (one at each node on the stem). Inflorescence a loose, elongated terminal raceme. Flowers white or pale bluish with darker blue lines, 1/6 to 1/3 inch across, with obvious pedicels (flower stalks) 1/16 to 1/4 inch long in axils of the small upper leaves. Seed capsules wider than high, with a notch at the upper end and the thin style sticking out from that notch (Figure 34B).

[redacted]).



[redacted]. *Thyme-leaved speedwell: A. plant; B. seed capsule on short stalk.*

C 34

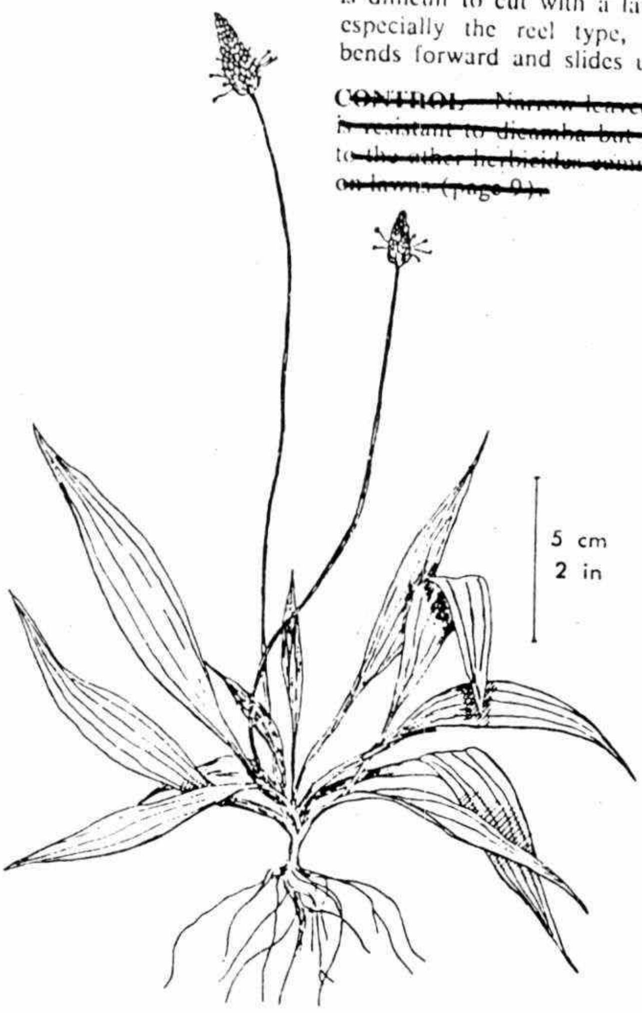
NARROW-LEAVED PLANTAIN

Plantago lanceolata **L.** (~~Figure 35~~)

Other names: rib-grass, buckhorn, English plantain

Perennial with fibrous roots. Leaves all basal in a rosette at the surface of the ground, long, narrowly elliptic, tapering to both top and bottom ends, and with three to several very prominent longitudinal veins. Flowers individually very small and inconspicuous, but numerous and densely packed in each short spike atop a long, thin, naked (leafless) stalk. This wiry stalk is difficult to cut with a lawn mower, especially the reel type, because it bends forward and slides underneath.

~~**CONTROL.** Narrow-leaved plantain is resistant to dicamba but susceptible to the other herbicides commonly used on lawns (page 9).~~



~~Fig. 35.~~ *Narrow-leaved plantain*

C.35.

BROAD-LEAVED PLANTAIN

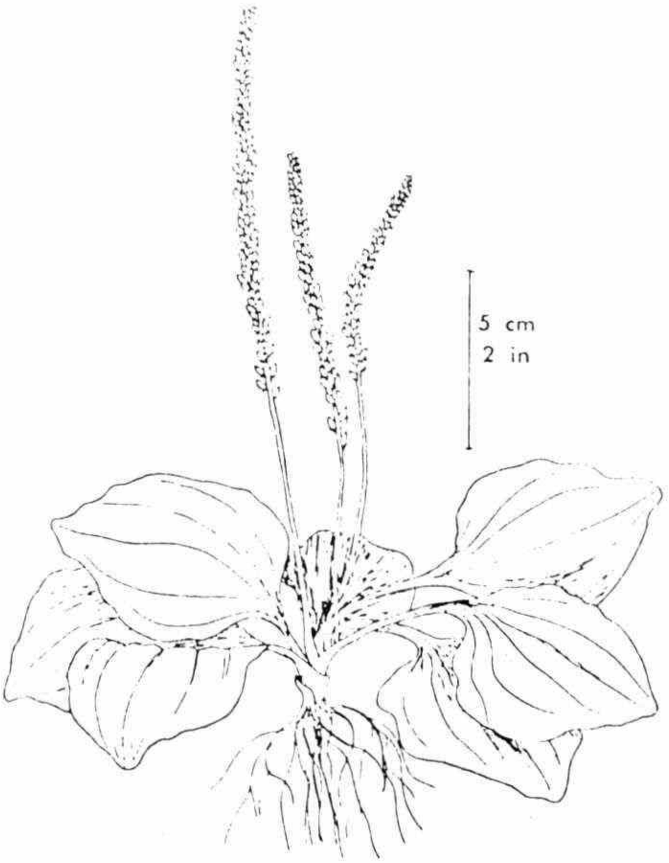
Plantago major L. ([redacted]

Other name: common plantain

Perennial with fibrous roots. Leaves all basal in a rosette at the surface of the ground, large, oval, width about 1/2 to 2/3 of length, with several prominent longitudinal veins, and narrowed to the leaf stalk; the leaf stalk thick and winged on each side (narrow lengthwise flanges of green, leaf-blade-like tissue). The base of each leaf stalk and thus also the center of the rosette green in color. Flowers individually small but numerous and loosely gathered together in a long thin spike atop a naked (leafless) stalk.

Rugel's plaintain (*Plantago rugelii* Dcne.) is very similar to broad-leaved plantain but is distinguished from it by the reddish base to the leaf stalks.

[redacted]).



[redacted] *Broad-leaved plantain*

C 36

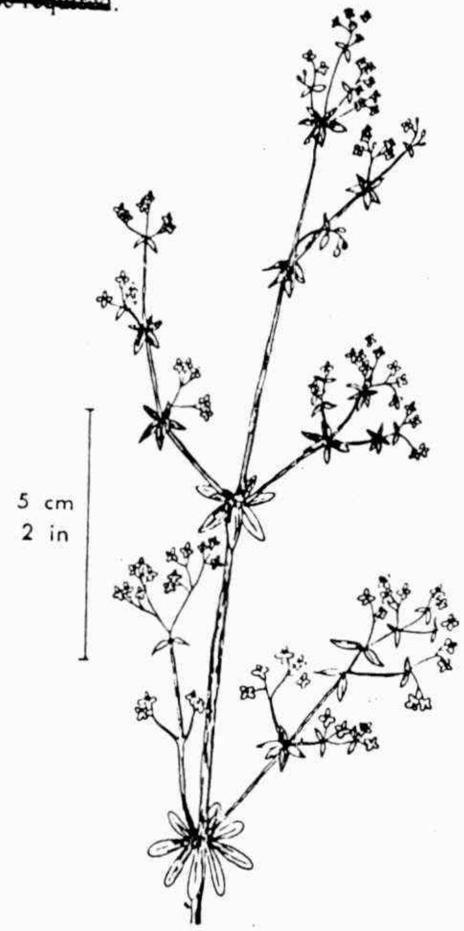
BEDSTRAW

Galium spp. (~~Figure 37~~)

Other name: cleavers

Perennial, with weak, spreading or trailing stems bearing whorls of six or eight (sometimes only four) narrow leaves at each node (joint). There are several kinds of bedstraws, distinguished only by technical characters. Stems square and smooth, except for one species that is covered with fine-hooked bristles (hence its former name of "cleavers"). The tiny white flowers (1/3 inch or smaller) have four petals and are in finely-branched clusters at the ends of branches.

~~CONTROL~~ ~~— All bedstraws are resistant to 2,4-D but may be controlled with the 2,4-D mixtures (page 9). Two applications, one in May, one in September, may be required~~.



~~Fig. 37~~. *Bedstraw*

C37

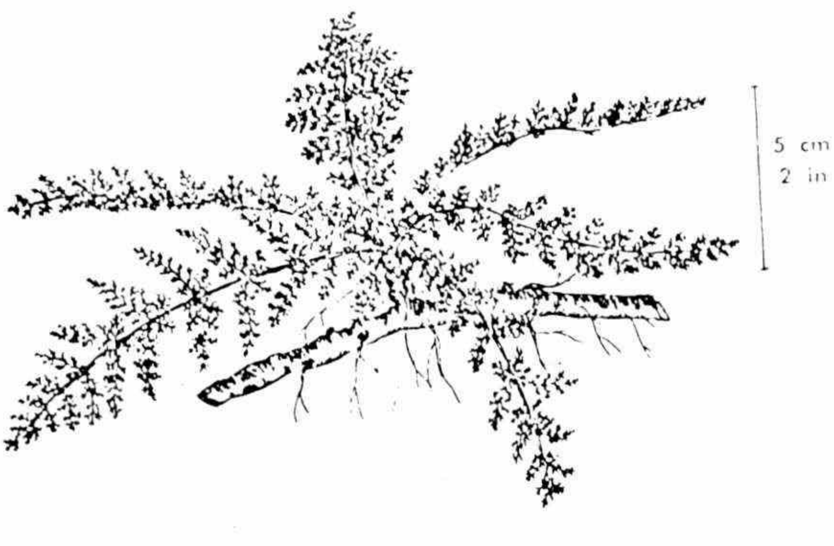
YARROW

Achillea lanulosa Nutt. ([redacted])

Other name: milfoil

Perennial, with creeping underground rhizomes. The plant is easily recognized in lawns by the very finely divided, green, feathery leaves in bushy clumps in the grass, and by their rather strong, sage-like odor. Leaves on the erect stems are also feathery but smaller. Flowers, rarely seen in lawns, are in very tiny heads and are clustered together in umbel-like bunches. The usual form of yarrow that is a weed in lawns has white flowers but sometimes the ornamental forms with pink or yellow flowers may also spread into lawns.

CONTROL Yarrow is difficult to control. A combination of good lawn maintenance and the use of [redacted] herbicide mixtures ([redacted]) will keep it in check. Probably it will be necessary to repeat the herbicide treatment two or three times to eradicate all plants. If the patches are small, they can often be dug out by hand successfully.



[redacted] 38. *Yarrow*

C 38

CREEPING BELLFLOWER

Campanula rapunculoides L. (~~Figure 38~~)

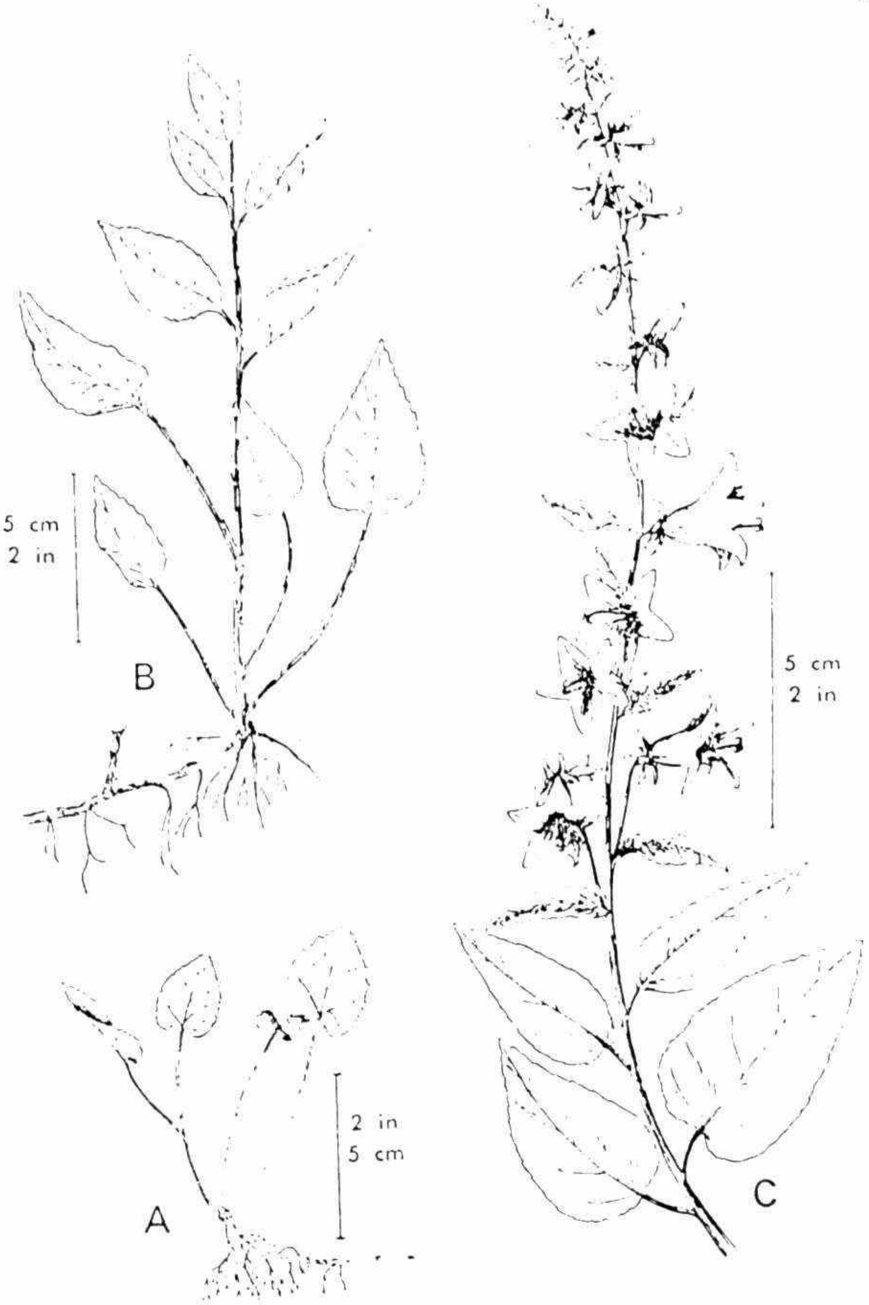
Other name: rover bellflower

Perennial with extensively-creeping, whitish, somewhat fleshy, underground rhizomes and enlarged tubers. Spreads both by seed and by producing new shoots from underground rhizomes and tubers. Before the flowering stem emerges, the first leaves arise singly or in clusters directly from the ground surface (Figure 39A), have long stalks and blades that are irregularly toothed, ovate, pointed at the tip and rounded to nearly heart-shaped at the base. On developing stems (Figure 39B) the leaves are alternate (one at each node on successively different sides of the stem), the blades get progressively narrower and the petioles (leaf stalks) shorter, until the upper leaves are narrow and sessile (no petiole, the blade attached directly to the main stem). Flowers blue, bell-shaped, about one inch diameter, ending in five uniform points, forming attractive, many flowered racemes at the ends of the stems (Figure 39C); the short pedicles (individual flower stalks) often curved to give the whole infloresecence a one-sided appearance. Seeds numerous and very fine.

Creeping bellflower is sometimes planted in ornamental borders but spreads into adjacent lawns by underground rhizomes and by seed. Flowering stems are rarely seen in well-mowed lawns but they may arise next to tree trunks, hedges or foundations.

CONTROL Creeping bellflower is resistant to selective lawn herbicides. However, as with goutweed [redacted] good lawn management should help reduce the problems brought about by the presence of this weed. Digging out clumps to remove as many rhizomes and tubers as possible and reseeding will speed up control.

C 39



Creeping bellflower: A, plant with basal leaves, B, plant with alternate leaves on developing stem; C, top of stem with bell-shaped flowers.

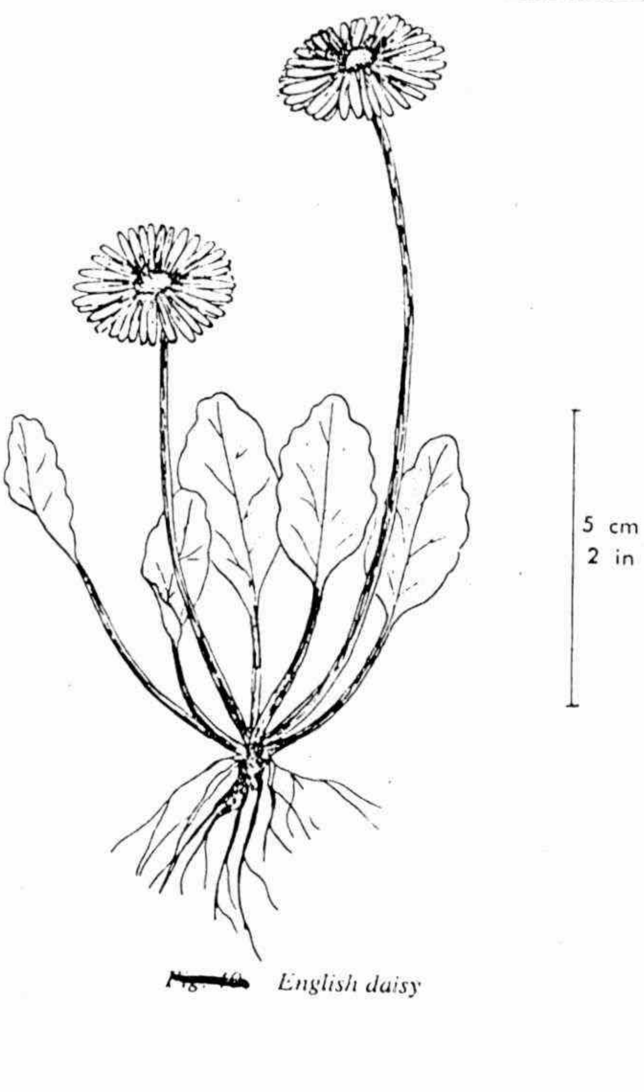
C 40

ENGLISH DAISY

Bellis perennis L. (Figure 40)

Perennial, with fibrous roots and rosettes of leaves lying close to the ground. Leaves broadly oval or club-shaped with wavy or toothed margins, a single prominent midrib and smaller branching veins, and fairly thick leaf stalks. Flower heads borne at the ends of leafless stalks arising from the center of the leafy rosettes. Flower heads 1/2 to 3/4 inch across, daisy-like, with the white to pink or purplish petals of the ray flowers around the outside and the dense yellow disc flowers in the center. Once established in a lawn it practically eliminates all grass growth.

~~**CONTROL.** Good lawn management coupled with June and September treatments with a 2,4-D mixture (page 9) will rid the area of this weed.~~



~~Fig. 40~~ *English daisy*

C41

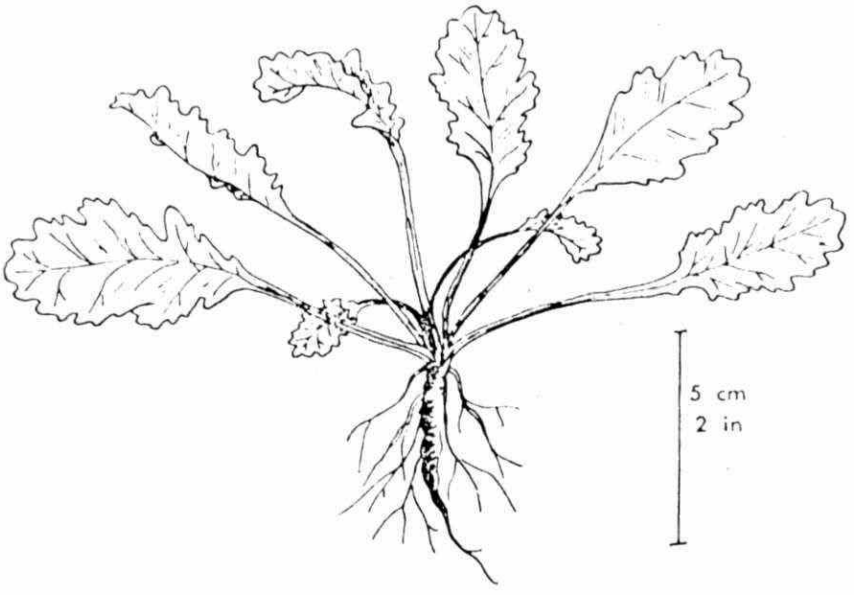
OX-EYE DAISY

Chrysanthemum leucanthemum L. ~~(Figure 41)~~

Other name: white daisy

Perennial with a short underground rhizome and producing dense tufts in the lawn. Stems erect or spreading erect but rarely producing flowers in a mowed lawn. Leaves in basal rosettes with definite petioles (stalks), dark green, rather shiny, oblong, coarsely and irregularly toothed; leaves on the stems with shorter petioles or sessile (no leaf stalk at all), more coarsely toothed or deeply cut, and the base of the blade clasping the stem. Flower heads resembling English daisy but larger and on leafy stems, each head 1 1/4 to 2 inches across, with the white petals of the ray flowers around the outside and the dense yellow disc flowers in the center. The whole plant has a sour, unpleasant odor.

~~**CONTROL.** Use 2,4-D in spring and fall. The various 2,4-D mixtures~~ [redacted]ul.



~~Fig. 41~~. *Ox-eye daisy*

C42

ANNUAL FLEABANE

Erigeron annuus **(L.) Pers.** (Figure 42)

Other name: daisy fleabane

Annual or biennial, developing a fibrous root system. Leaves at first in basal rosettes, moderately large and long-stalked; the blades thin, elliptical, coarsely toothed and somewhat hairy. Stem leaves narrower, short-stalked or sessile (no stalk) but the base of the blade never clasping the stem. Stems erect but rarely produce flowers in a lawn. Flower heads resemble English daisy but smaller, about 1/2 inch across with very thin and numerous white or sometimes mauve petals on the ray flowers around the outside and dense yellow disc flowers in the center.

Philadelphia fleabane (*Erigeron philadelphicus* L.) also may appear in lawns. The rosette stage is very similar to annual fleabane but it is a perennial that spreads both by seed and underground rhizomes, and its stem leaves are sessile (no leaf stalk), have shallow teeth, and the leaf bases clasp the stem.

CONTROL Fleabanes are seldom found in established, well-maintained lawns. ~~Usually two applications of 2,4-D or the mixtures (page 9) will eliminate the annual kind from lawns but additional treatment may be necessary for the perennial kind~~.

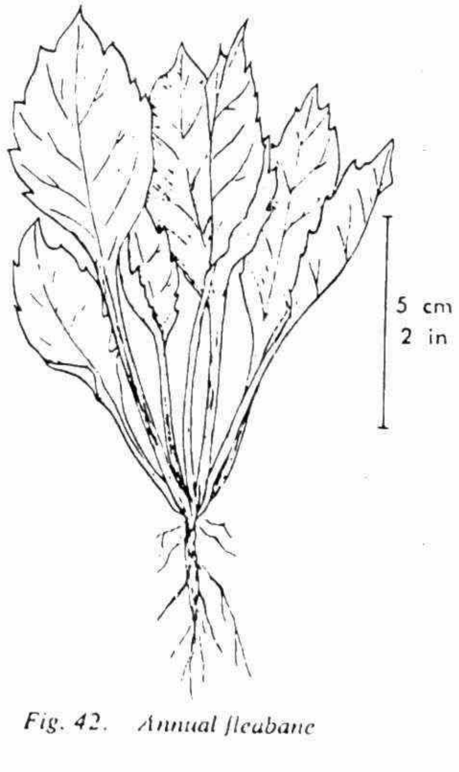


Fig. 42. Annual fleabane

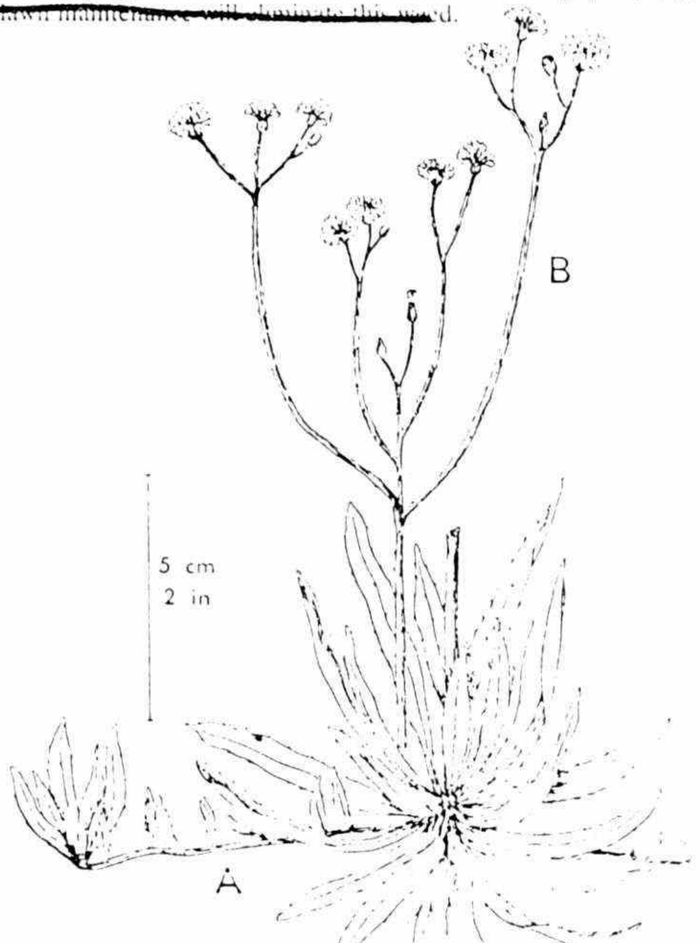
C43

HAWKWEEDS

Hieracium spp. (Figure 43)

Several kinds of hawkweeds may appear in lawns (yellow hawkweed, king devil hawkweed, orange hawkweed, mouse-eared hawkweed, etc). All are perennial and since mowing modifies their appearances greatly, it is difficult to determine the particular species that may be present. In general they have rosettes of basal leaves which are long and narrow, or club-shaped, and usually hairy. Some reproduce by runners. If the flowers do form, they are small, dandelion-like, produced in clusters at the ends of long, leafless stalks, and are mostly yellow; in one species, orange.

[redacted]



[redacted]. *Yellow hawkweed: A, plant with rosette of basal leaves and leafy runners; B, flowering stem.*

C44

DANDELION

Taraxacum officinale **Weber.** (Figure 44)

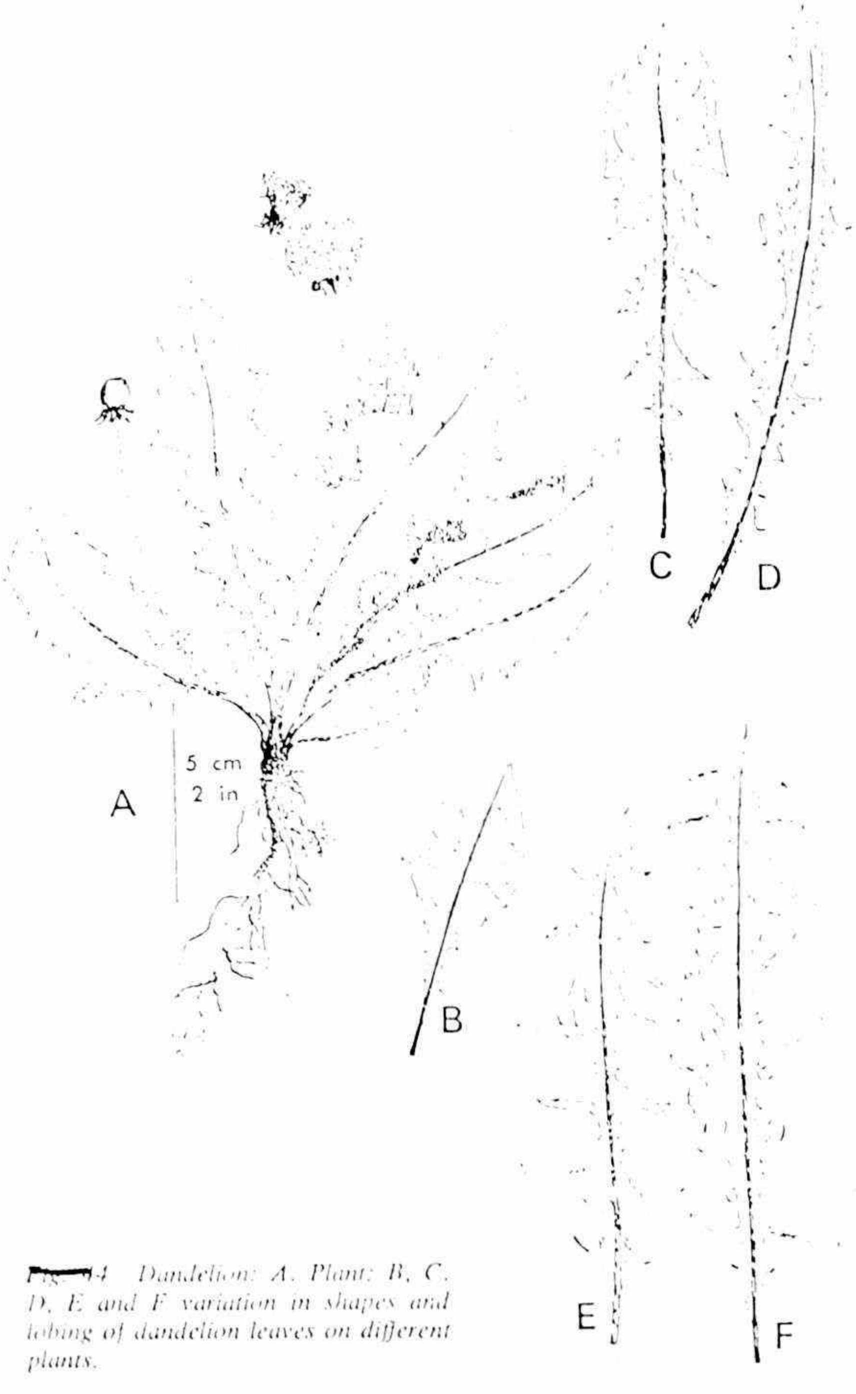
Perennial with a taproot. Leaves in a basal rosette, elongate, shallowly toothed or more often deeply and irregularly lobing along each side, the amount and shape of toothing or lobing being extremely variable from one plant to another (see illustrations of some of the variations, Figures 44 A-F). Flower heads bright yellow, each head at the end of a long, smooth, leafless, unbranched stalk that rises from the rosette of leaves. All parts filled with a milky juice.

Perennial sow-thistle (*Sonchus arvensis* L.) and **chicory** (*Cichorium intybus* L.) may invade lawns occasionally and are sometimes mistaken for dandelion because their young rosette leaves are similar in size and shape and all have milky juice. Sow-thistle leaves have weak prickles on the margins and chicory leaves are rough-hairy. Both have leafy flowering stems. Sow-thistle is a rhizomatous perennial with yellow flowers and chicory is a tap-rooted perennial with blue flowers.

~~**CONTROL** Dandelion is easily controlled with 2,4-D, or any of the 2,4-D mixtures.~~ Digging out the individual plants with a knife may not be satisfactory because the portion of the taproot that remains in the ground can sprout and produce two or three new plants where there was only one before.

~~Chicory and perennial sow-thistle can be controlled by repeated applications of 2,4-D or the 2,4-D mixtures (page 9)~~.

C45



[redacted] *Dandelion: A. Plant; B, C, D, E and F variation in shapes and lobing of dandelion leaves on different plants.*

C46

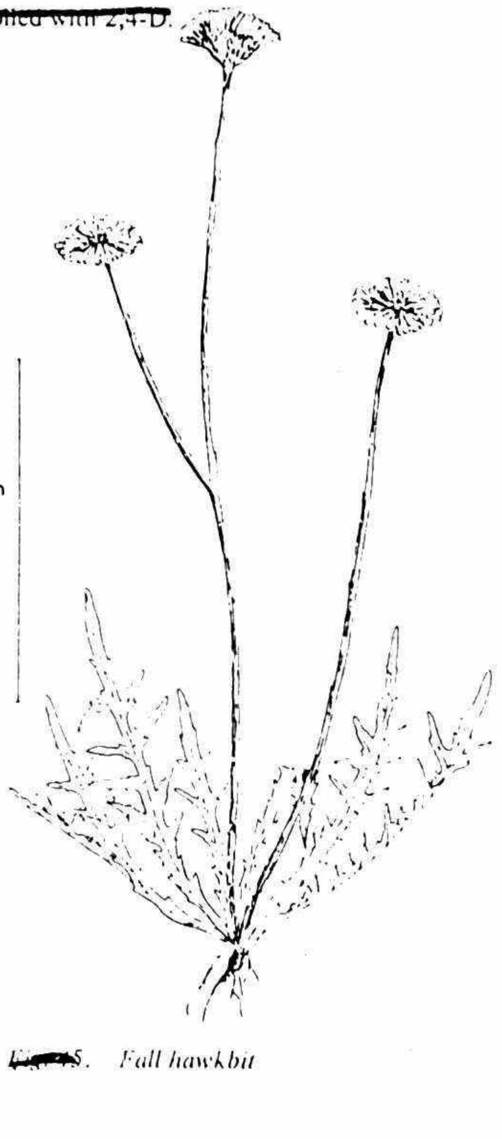
FALL HAWKBIT

Leontodon autumnalis L. (Figure 45)

Other name: fall-dandelion

Perennial with a fibrous root. Leaves in a basal rosette, elongate, deeply divided along each side with narrow, widely-spaced lobes; some leaves not divided. Flower heads yellow, resembling dandelion but smaller, on long, thin stalks; these flowering stalks rise from the center of the rosette of leaves, may be branched or unbranched, and usually have several scaly bracts resembling tiny leaves on the upper parts.

~~CONTROL — Easily controlled with 2,4-D.~~
(See page 9.)



[redacted]5. *Fall hawkbit*

CHEMICAL CONTROL

The herbicide 2,4-D has been the answer to many problems connected with the maintenance of a neat, weed-free lawn. It is inexpensive, readily available, easy to apply, and will control many of the common weed species. However, 2,4-D does not give good control of certain common lawn weeds such as mouse-eared chickweed, black medick, and ground-ivy. Fortunately other chemicals related to 2,4-D (mecoprop, dichlorprop, fenoprop and dicamba) can kill most of these weeds.

Mecoprop is safe to use on all grasses, including the bent grasses, and has been widely accepted. It is slow-acting, however, and gives only fair control of dandelions. Fenoprop, on the other hand, kills more quickly and affects a wider range of weed species but sometimes, particularly during hot weather, it damages turf. Fenoprop should *never* be used on bent grass.

Dicamba is particularly useful for the control of knotweed in lawns. It also gives excellent control of most other weeds, with the notable exceptions of broadleaved plantain and narrow-leaved plantain. Dicamba has had harmful effects on several species of shrubs commonly found near lawns. This herbicide may remain active in the soil for long periods of time and may be absorbed through the roots of susceptible woody plants. Therefore, dicamba should not be applied within the "drip-line" of shrubbery, nor at rates higher than 8 oz of active ingredient per acre (¼ oz of active ingredient per 1400 sq ft) of lawn surface. Since the rates recommended on most labels are considerably lower than this, the homeowner should have no fears about using dicamba, as long as he follows the directions on the label carefully.

It is apparent that none of the herbicides mentioned above is effective on all of the many species of weeds found in lawns. However, mixtures of 2,4-D with mecoprop, dichlorprop, fenoprop, and/or dicamba have been found to control most lawn weeds. Such mixtures are available from most garden supply stores. Since formulations differ, it is impossible to give one overall recommendation as to the amount of products to use. Follow the manufacturers' directions on the label for best results.

WARNING

~~One cannot place too much emphasis on the warning that herbicides must be used as directed, and must be kept away from desirable border or garden plants. Careless mixing, spraying when the wind is blowing, holding the spray nozzle high, or using spraying or mixing equipment for any other purpose will certainly lead to unsatisfactory results or damage to desirable plants. Follow carefully manufacturers' directions given on the labels.~~

TABLE 1. A summary of herbicides used to control lawn weeds C48

(See page 8 to 54 for details)

Weed	*Growth* Habit*	*Herbicide***	*Remarks*
Bedstraw	p	mixtures	repeat treatment
Bellflower, creeping	p	none, see page 46	hard to kill
Bindweed, field	p	2,4-D	repeat treatment
Blueweed	b	2,4-D, mixtures	repeat treatment
Buttercup, creeping	p	MCPA, mixtures	repeat treatment
Chickweed, common	a-wa-p	mixtures	readily controlled
Chickweed, mouse-eared	a-p	mixtures	readily controlled
Cinquefoil, silvery	p	2,4-D, mixtures	repeat treatment
Daisy, English	p	mixtures	repeat treatment
Daisy, ox-eye	p	2,4-D, mixtures	treat when young
Dandelion	p	2,4-D	readily controlled
Dock	p	2,4-D, mixtures	treat when young
Fleabane, annual (daisy)	wa	2,4-D, mixtures	treat when young
Goutweed	p	none, see page 35	hard to kill
Grass, annual blue	a	see page 12	improve turf
Grass, crab	a	see page 14	preemergence
Grass, quack	p	none, see page 10	try to crowd out
Ground-ivy (creeping Charlie)	p	mixtures	treat when young
Hawkbit, fall (fall dandelion)	p	2,4-D	readily controlled
Hawkweed	p	2,4-D, mixtures	repeat treatment
Heal-all	p	mixtures	treat when young
Knotweed, prostrate	a	dicamba	treat when young
Mallow	a-b-p	mixtures	hard to kill
Medick, black	a-wa	mixtures	treat in June
Moss	p	none, see page 6	improve turf
Mushrooms and Toadstools	p	none, see page 6	improve turf
Pearlwort, bird's-eye	a-p	mixtures	treat when young
Plantain, broad-leaved	p	2,4-D	readily controlled
Plantain, narrow-leaved	p	2,4-D	readily controlled
Sandwort	a	mixtures	readily controlled
Shepherd's-purse	wa	2,4-D	treat when young
Speedwell, corn	a	mixtures	hard to kill
Speedwell, purslane	a	mixtures	treat when young
Speedwell, thyme-leaved	p	mixtures	treat when young
Stonecrop	p	mixtures	treat when young
Violet	p	mixtures	repeat treatment
Yarrow	p	mixtures	hard to kill

* a = annual, b = biennial, p = perennial, wa = winter annual.

** "Mixtures" refers to commercially available combinations of 2,4-D with mecoprop, dichlorprop, fenoprop and/or dicamba. If using 2,4-D alone use a rate of 1 oz of active chemical in 4 gal of water on 2500 sq ft of lawn. If using one of the mixtures, carefully follow the manufacturer's directions. For use on home lawns, these chemicals are available only in amine formulations so their volatility (giving-off vapors) will be very low.

ESTABLISHED LAWNS

In an established lawn, most weeds can be controlled satisfactorily by following proper lawn care practices. These include fertilization, topdressing, mowing, watering, aerifying, and the reseeding of sparse areas. The idea behind such procedures is to produce a dense, healthy turf that will compete so strongly for water, light and nutrients that weed seedlings cannot become established. In practice weed-killing chemicals work extremely well when used with the other cultural methods mentioned above.

Most broadleaved weeds are susceptible to 2,4-D and related chemicals but most grasses are resistant. Therefore, these chemicals may be used on lawns without any danger of injury if manufacturers' directions are followed. See specific recommendations for different weeds. Apply the solution to wet the weeds thoroughly.

NEW LAWNS

When establishing a new lawn, consider the possibility of having a weed problem in the established turf before the soil is prepared for seeding. Thorough cultivation at intervals during the summer before planting or laying sod is desirable. This encourages germination of weed seeds already in the soil; seedling weeds emerging after one cultivation are easily killed by the next. Where such perennial weeds as quack gradd, brome grass, field bindweed, ground-ivy, goutweed, or creeping bellflower are known to be present, it is essential to try to eliminate these before seeding or laying sod. As many possible of the roots and rhizomes (underground stems) of these creeping perennials should be dug out with a fork. Rhizomes that penetrate below the depth of normal cultivation are more likely to be removed if forked out before cultivation begins. Following each cultivation, roots and rhizomes should be raked up and removed from the lawn area.

The seed bed can be treated with metam sodium (Vapam or VPM) to kill weed seeds, some perennial roots and rhizomes or soil-borne fungus diseases and nematodes in the soil before planting. Metam sodium is applied in a water solution as a soil drench. It gives off vapors which must be properly distributed through and kept in the soil for an adequate period of time and later dissipated from the soil. It must not be used in confined spaces because of the vapors.

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Certain other chemical treatments can also be used on seed beds before planting. These include fumigation with methyl bromide (class 10 land exterminator's licence needed) or drenching with allyl alcohol. Paraquat (Gramoxone) is a chemical that kills plants on contact but is inactivated by soil. It can be used to kill weeds and grass in old ragged turf, after which the ground is rototilled, the debris raked off and the soil smoothed for reseeding the grass. All may be used before seeding a new lawn. However, because of their high toxicity, these materials can only be applied by licensed exterminators.

After seeding a lawn, many annual weeds may emerge before the grass seedlings are up. If these young weeds are not controlled they will shade and eventually crowd out much of the grass population. Mowing with the mower set to cut as high as possible will eliminate many such weeds. If they are extremely thick, 2,4-D at one-half the usual rate (1 oz active in 8 gal of water per 2500 sq ft) or mecoprop (1 oz active in 4 gal per 2500 sq ft) can be used - but not before the grass has been up at least four weeks.

During the early development of a lawn the grass should not be cut too short. When most of the leaf surface of a grass plant is removed, a deep and extensive root system cannot be produced. In such an event the grass will not be able to complete with weeds or weedy grasses for water and nutrients, and the weeds will soon take over. A similar problem will develop if superficial watering or poor fertilization practices are carried out.

Although spraying is the best and least expensive method of treatment, other methods have been and are being tried in an effort to increase convenience and reduce the possibility of injury to desirable plants. Granular formulations are available which may be applied dry with a fertilizer spreader. Also, mixtures of granular herbicides with fertilizer are available. Such mixtures give good weed control and are convenient to the homeowner since only one operation is required to both fertilize and weed the lawn. Granular materials should be applied in two directions at right angles to each other to obtain complete coverage. Do not use such materials for fertilizing shrubs, gardens or flower beds. The herbicide component of such mixtures may damage or destroy the desirable plants.

Various formulations are available as aerosols for spot-treatment of lawn weeds. Relative to spraying this is an expensive way to apply herbicides, but it is convenient and has a place when only a few scattered weeds are present in the lawn.

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WARNING

Do not use 2,4-D, fenoprop or dicamba on bent grass or newly-seeded lawns.

TIME OF SPRAYING

Regardless of the type of application, best weed control by 2,4-D and related herbicides is obtained when the treated plants are growing rapidly. In general, the younger a plant is the more susceptible it is to these chemicals; so the sooner the spray can be applied after weeds emerge the more effective will be the control. Treatment should be carried out in May or early June, or in September, or at both times if the weed population warrants it. Fall spraying has an additional safety advantage since most cultivated plants in gardens and borders are less sensitive to sprays at this time than in the spring. Also, fall spraying ensures that the lawn will be free of dandelions in the next spring.

Herbicides should not be applied during the hot days of summer as damage to the turf grasses may occur. Application should not be made within one day of mowing, or for two or three days after mowing to ensure adequate coverage and penetration into the weeds.

Preemergence chemicals, such as those recommended for the control of crab grass, must be applied before the weed seedlings emerge through the soil surface.

CLOVER IN LAWNS

To some people, clover is desirable in a lawn. Because it is deep rooted, it stays green during the dry season. And, because it is a nodulated legume, it fixes nitrogen from the air so does not require additional nitrogen fertilizer. If clover is to be kept in the lawn, 2,4-D must be used with caution when controlling other weeds. The rate of 2,4-D recommended for control of most weeds will check the growth of clover and perhaps thin the stand in an established lawn, but will not eradicate it. Do not use mecoprop, dichlorprop, fenoprop or dicamba, or mixtures containing them as they will kill clover.

To other people, clover is a weed to be removed! It stains shoes and clothing of children playing on the lawn. It tends to grow in patches and may thin out the grass so much that

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bare soil is exposed after the clover leaves are killed by fall frosts. Clover can be eradicated easily by spraying with mecoprop, dichlorprop, fenoprop or dicamba at the rate of 1 oz in 4 gal of water per 2500 sq ft. Any of the mixtures containing 2,4-D and one or more of these herbicides will give excellent control.

MOSS

Moss is a problem in lawns only where growing conditions are not suitable for grass. Moss and grass have different requirements. Shade, poor drainage and low fertility are the most common conditions that encourage moss growth but retard or inhibit grass growth. The causes of these poor conditions must be removed before the moss problem can be permanently corrected. If trees or shrubs cause the shading, they may be pruned back or thinned out to let more light through. Rerouting runoff waters, installing gravel or tile drainage beneath the lawn, or raising the lawn surface by adding soil will help alleviate poor drainage. Growth of grass can be further encouraged by adding the correct fertilizers, especially where the soil is low in fertility, or where tree or shrub roots may be competing for moisture and nutrients. Where shading cannot be corrected (e.g. buildings or tall fences) the use of a more shade-tolerant grass such as rough-stalked blue grass, or some other shade-tolerant ground cover should be considered.

MUSHROOMS AND TOADSTOOLS

"Fairy-rings" or mushrooms are sometimes found in lawns. These mushrooms are the reproductive (spore-producing) parts of a fungus that lives on rotting organic material that is buried in the soil. They emerge when the temperature and moisture level are just right. The turf often shows circular areas of injury due to the active fungus affecting the moisture supply.

Soaking the infested areas with plain water every day for a month will usually accomplish satisfactory control. Soil in the "fairy-ring" is usually hard and dry. Wetting it is difficult because the dense mycellium ("roots" of the fungus) makes the soil resistant to water absorption. Repeatedly plunging a garden fork to the full depth of its tines every inch or so across the "fairy-ring" during each watering will break the mycellium apart and aid in water penetration and soaking of the soil. Correct fertilization will also help by fostering a vigorous growth of turf.

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UNWANTED GRASSES

Several weedy grasses may appear in the lawn. Some are annuals, others tufted perennials, and still others creeping perennials. All have some undesirable feature or features that make them unsuitable in a lawn. If their normal growth habit is erect and they grow more rapidly than the lawn grass, they will produce a ragged or tufted appearance very soon after mowing. Annuals die out at the end of their growing season and leave patches of brown stems or bare soil. Some can produce numerous seed heads between successive mowings or even below mowing height and these also give an unsightly appearance to the lawn.

The commonest weedy grasses are crab grass, quack grass and annual blue grass and these are dealt with individually [redacted]. Other weedy grasses, [redacted], include the creeping perennials; smooth brome and creeping bent grass; the tufted perennials; orchard grass, timothy, meadow fescue and foxtail barley; and the annuals: witch grass, barnyard grass, green foxtail and yellow foxtail.

CONTROL

There is no chemical presently available that can be used to kill these weedy grasses, once they are growing in a lawn, without damage to the desirable turf species (with the possible exception of creeping bent grass).

Maintenance of a dense, healthy turf cannot be overemphasized. A proper program of mowing, fertilizing, watering, and disease control will produce and maintain a dense, vigorous turf because the grasses used for home lawns are adapted to grow well under those conditions. Not so with the weedy species, both broad-leaved and grass kinds! Seedlings of annual grasses are unable to survive the competition from a vigorous turf and die before they become a problem. Established plants of most tufted and creeping perennial weedy grasses tend to grow faster and more erect than turf species. Repeated mowings cause proportionally more damage to the weedy kinds than to the desirable kinds. Gradually the food reserves stored in their underground parts become exhausted and ultimately they die. But this may take 2 or 3 years or even longer. For immediate results, the best method is to dig out isolated patches and reseed or resod.

Creeping bent grass sometimes grows in very dense patches in lawns where it may crowd out other desirable turf species. It is very shallow-rooted so is most likely to be a problem in lawns that are lightly sprinkled at frequent intervals. Repeated treatment with fenoprop (1 oz in 4 gal per 2500 sq ft) followed by topdressing with soil and reseeding will give satisfactory control.

Annual grasses are found in many lawns, particularly where the turf is thin or lacks vigor. Chemical control of most of these grasses is possible, but only if applied before their seeds germinate. Use the preemergence chemicals as described for crab grass.

BRUSH CONTROL

Brush is often a minor problem on roadsides but may be the total problem on utility lines. The type of brush and local circumstances can make brush control as complicated as weed control. Often these programs will complement each other, as a good weed program will control most small brush and a straight brush program will control many weeds. As in weed control the problem must be carefully assessed and properly planned.

Points to consider would include:

* A list of species and their growth habits.
* Most practical method and time of application.
* Most effective material or combination.
* Susceptible crops in the area.

GROWTH HABITS OF DECIDUOUS AND EVERGREEN BRUSH

DECIDUOUS refers to those species of trees or brush which lose their foliage in the fall and produce new leaves in the spring such as alder, ash, maple, poplar and willow.

EVERGREEN refers to those species of trees or brush that retain foliage year round, such as balsam, cedar, pine, juniper, yew and larch (tamarack). Although larch lose their leaves in the winter, they are classed with the evergreens. Evergreens require a different treatment than deciduous species.

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CLASSIFICATION OF WOODY PLANTS IN RELATION TO SUSCEPTIBILITY TO FOLIAGE SPRAYS OF 2,4-D, 2,4,5-T, AND 2,4-D/2,4,5-T MIXTURES

Class 1 Susceptible: Usually killed by one application of 2,4-D at 32 oz acid per 100 gal water.

Class 2 Intermediate: Usually require more than one application of 2,4-D at 32 oz acid per 100 gal water.

Class 3 More Susceptible to Mixtures of 2,4-D and 2,4,5-T than to 2,4-D alone. Apply 32 to 48 oz acid per 100 gal of water.

Class 4 Resistant: Control not practical with above chemicals.

Class	
1	Alder
3	Ash
2	Aspen Poplar
2	Balsam Poplar
3	Barberry, Common
3	Basswood
3	Beech
1	Birch
3	Blackberry
1	Blueberry
3	Buckthorn, Common
1	Cherry, Wild
4	Conifers, Cedar, Pine, Spruce
3	Currants
3	Dogwood
1	Elderberry
2	Elm
2-3	Hawthorn
2	Hardhack (Spirea)
3	Hickory
1	Honeysuckly
3	Hornbeam
3	Lilac
1	Maple
3	Oak
2-3	Poison Ivy
3	Raspberry, Wild
3	Rose
1	Sumach
1	Virginia Creeper
1	Wild Grape
1	Willows

SELECTING HERBICIDES AND TECHNIQUES FOR BRUSH

Because of the wide range of herbicide formulations available in liquid and dry form the operator should be able to select a program that will provide the desired results on all the species present.

STEM FOLIAGE TREATMENT

This is a spray applied, between the time of full leaf development and the first frost in the fall, to the stems and foliage of the brush in such a manner that both are wet to runoff.

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It is applied as a high-volume spray averaging around 100 gal of solution per acre. Growth over 6 or 7 feet, except willow-type brush, should be cut and the regrowth sprayed when it is about three feet tall. Spraying the regrowth will take less material, make it easier to get good coverage, lessen drift problems and leave a better appearance. Formulations of 2,4-D and 2,4,5-T in water are generally recommended. However, when evergreens are present, other chemicals must be used, either alone or in mixtures.

BASAL-BARK TREATMENT

Basal-bark treatment is another method of control of brush or small trees with a trunk diameter of less than six inches. A brush-kill combination of 2,4-D/2,4,5-T or 2,4,5-T is applied in oil to wet the lower trunk and exposed roots thoroughly. Complete wetting of the centre stems of clumping bushes is necessary for a kill. This type of control can be applied any time of year on most species. Brush species on the noxious weed list, such as barberry and buckthorn, are among the hardest to kill and should receive detailed attention.

STUMP TREATMENT

This is a spray applied to the freshly-cut stump to prevent regrowth. A strong solution of 2,4-D/2,4,5-T in fuel oil, Ammate or Sodium Chlorate may be used. The cut surface is sprayed to runoff with enough material to wet the stump thoroughly to ground level and to soak any exposed roots.

DRY TREATMENT

Several brush-killing chemicals are now on the market for dry application in granular or pellet form. These materials may be applied broadcast or used for individual treatment. These materials are easy to transport or to carry and can be applied by hand. They are excellent for spot treatments.

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SOIL STERILANTS

The use of soil sterilants around guide rails, sign posts, storage yards, paved medians, bridges and buildings, greatly reduces the amount of labor necessary to keep these areas free of vegetative growth. Soil sterilants are chemical materials which, when applied to the soil surface, kill existing growth and also prevent new growth for periods of one to three years. Soil sterilants act principally through the roots of the plant. The length of time they remain effective in the soil will depend on the chemical, the rate, application, the species and soil conditions.

Applications on the soil surface require moisture, generally in the form of rain, to be carried down into and distributed through the root zone. The amount of rainfall has a marked influence on the length of time soil sterilants remain active in the soil, and determines the time when applications should be made for best results. Sterilants can leach from the treated area under certain conditions causing damage to the adjacent grassed areas. This leaching has been most apparent on recently completed construction where the turf has not had time to become established or where a heavy rainfall occurred within a few days after application of the herbicide.

The spray should be applied as uniformly as possible at a low spraying pressure. If granulars or dry powder are used they must be applied uniformly and at the recommended rate. The sterilant, when applied to guide rails, should be applied as close to the back of the post as possible in order to keep the leaching to a minimum. Under no circumstances should the solution be spilled or sprayed on any paved areas.

When spraying sterilants, the following precautions should be observed:

(1) Take every precaution to confine the spray pattern to the area to be treated.

(2) Use as low a pressure and as large a tip or nozzle as possible to reduce the possibility of drift damage.

(3) Stop all spraying when the wind is strong enough to carry the spray particles in droplet form (drift) away from the area being treated.

(4) Do not use soil sterilants on recently completed construction projects where movement of the sterilants to untreated areas can be anticipated.

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CHEMICAL WEED CONTROL IN NON-CROP AREAS

TREATMENT WITH SOIL STERILANTS - Perennial weeds may be eradicated and the growth of annual weeds prevented by the use of chemicals which temporarily sterilize the soil. These soil sterilants may be applied at any time. Best results are obtained if application is followed by a period of rainfall.

TREATMENT WITH TRANSLOCATED CHEMICALS - In eradicating perennial weeds, heavier dosages of 2,4-D and other translocated chemicals than would normally be used in cropland must be applied. Mixtures of 2,4-D with other chemicals may be used to keep areas free from vegetation.

TREATMENT WITH CONTACT CHEMICALS - These chemicals are not selective but kill all foliage they contact. While this will kill annual weeds, regrowth usually develops from the roots or crowns of perennial plants.

Once a person has identified the weed problem it becomes necessary to be knowledgeable of the herbicides which may help alleviate the problem.

The grower should not rely on only one chemical or practice over a period of years. For example, 2,4-D controls most broadleaf annual weeds but it does not kill grasses. When the broadleaf weeds have been killed, the weeds not controlled can become a serious problem.

The susceptibility of both crops and weeds to herbicides is related to the time of application. Therefore, it is important to use the chemical at a time when the crop is at its maximum resistance and the weeds are at their maximum susceptibility. This time will vary depending on the crop involved and the herbicide being used. Different terms of describing the times at which herbicides may be applied have come into general use. Unless specified differently, these times refer to the stage of development of the crop plants.

COMMON HERBICIDES AND THEIR PROPERTIES

AATREX (see Atrazine)

AMIBEN (see Chloramben)

AMITROLE, AMITROLE T

Amitrole is available as a soluble powder and as a liquid, and is active against a wide range of plants. It is particularly useful for the control of quack grass, poison-ivy, milkweed, Canada thistle and cattails. The chemical is readily absorbed by both the roots and tops and its action is characterized by a chlorosis, or bleaching, of newly developing shoots. The chemical is also translocated within the plant. Spray operations should emphasize a thorough wetting of actively growing vegetation.

This non selective herbicide breaks down readily and if not taken up by the plant is effective only for a short period. Amitrole is readily soluble in water and may be mixed with other chemicals such as 2,4-D, monuron, simazine, and dalapon for use in mixed vegetation. The poison hazard during application is very slight, amitrole is noncorrosive and can be readily washed out of equipment with soap and water.

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A mixture of amitrole with ammonium thiocyanate is marketed as a liquid called Amitrole T. Some reports indicate that control of quack grass is better than with amitrole.

Heavier doses of amitrole T will leave the soil barren for a period of time. A few crops, ~~for example corn~~, have a degree of tolerance. However, if the area is to be sown, follow manufacturer's directions closely.

AMIZINE

This product is effective as a general weed killer for use on non-cropped land. Amizine is a combination of two chemicals - amitrole and simazine. This combination product can be used effectively for soil sterilization. The herbicidal activity of amitrole destroys the existing vegetation and simazine provides long-term maintenance of the weed-free areas produced. Uniform coverage is important and touch-up operations may be necessary.

AMMATE X (AMMONIUM SUFFAMATE)

A granular or crystalline material that is used for the eradication of vegetation. It may be applied as a soil sterilant either in solution or in dry form.

This chemical may be used as an overall spray for weeds and small brush, as a stump treatment to prevent resprouting, and for the eradication of poison-ivy and creeping-rooted perennial weeds by preventing all plant growth on the treated area. It acts by contact and translocation and is a good contact killer of many herbaceous perennials. It also kills most seedling weeds.

Ammate is not a fire hazard and is not poisonous to livestock. Spray equipment should be washed thoroughly after use as this chemical is corrosive to metals, especially brass and copper.

Amizine leaches quickly from soil and is rapidly broken down by soil micro-organisms.

ATLACIDE (SEE SODIUM CHLORATE)

ATRAZINE (AATREX)

Atrazine is actively absorbed both through the root system and foliage

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Atrazine can persist in the soil for varying lengths of time, depending on the weather and soil conditions (longer under dry, cool weather and sandy soils). Granular formulations give longer soil residues than liquid or wettable powder formulations. Thorough agitation is required in the spray tank to keep atrazine suspended.

It is non corrosive and non flowable but the wettable powder formulation is somewhat harsh on spray pumps and nozzles.

BANVEL LIQUID HERBICIDE (see DICAMBA)

BASFAPON (see DALAPON)

BENSULIDE (BETASAN)

For preemergence control of annual grasses in established lawns. Available as an emulsifiable concentrate, a granular, and in fertilizer mixtures. It will remain active in the soil over winter, so may be applied in the fall for crabgrass or annual bluegrass control the following summer.

This material is non-corrosive. Fish and other aquatic life can be injured.

BORON COMPOUNDS (BORAX)

Boron compounds are relatively persistent in the soil and are used as soil sterilants. They are particularly effective against leafy spurge. The action of these chemicals is largely through the roots. Certain species of grasses are somewhat tolerant to boron compounds and often are the first plants to revegetate treated areas. These herbicides are nontoxic and noncorrosive. They may be applied directly or in mixtures with 2,4-D, sodium chlorate, or substituted urea. When mixed with sodium chlorate, the boron acts to reduce the fire hazard associated with the chlorate.

Boron compounds are slightly corrosive and are quite stable. Persistence is usually one year or more, but they leach quite rapidly in high rainfall areas.

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BROMACIL - HYVAR X

Bromacil is a substituted uracil available as a wettable powder or a soluble powder. In the soluble form it dissolves with stirring and remains in solution. Weed destruction is rapid with a minimum of rainfall at recommended rates. Persistence in the soil is equal to diuron. It is particularly effective when used at 1 to 3 lb active for annual control of all growth in combination with paraquat, sodium chlorate, or oils. Bromacil should NOT be used where it is likely to leach, wash, or move with eroded soil into contact with the roots of desirable trees and shrubs.

It is a very effective broad spectrum sterilant and provides good control of many species. The chemical works primarily through the roots and hence must be activated by moisture. Noncorrosive and stable it is of low toxicity but may cause skin irritation. Bromacil is used on non-crop land like railways and rights of way.

BROMOXYNIL - BROMINAL

Bromoxynil ester is formulated as an emulsifiable concentrate which is absorbed by plant foliage and moves very little within the plant. Wild buckwheat, smartweed, lamb's-quarters, and wild mustard are killed by 6 oz per acre if the chemical thoroughly contacts these plants before they have more than 4 true leaves. Most established perennial broad-leaf weeds, chickweed, and grasses tolerate applications of this herbicide. The formulation includes a wetting agent to improve the spread of droplets on the leaf but 15 to 20 gal of spray solution per acre should be used to ensure good coverage of the weeds. Commercial formulations of bromoxynil and MCPA ester (1:1 ratio) are also available. These formulations give better control of mustards than bromoxynil alone. Bromoxynil has been detected in plants 6 weeks after application, but it has a low order of mammalian toxicity. Although bromoxynil is not an effective soil-applied herbicide, broadleaf crops such as turnips, peas, and beans should not be seeded for a week after spray application.

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BUTYRICS - 2,4-DB, MCPB

These chemicals are 2,4-D like in nature, but differ from this chemical in their activity towards certain plant species. Thus clovers, peas and flax will tolerate dosages of these chemicls that will control weeds such as Canada thistle. The formulations of butyrics and their application follow the pattern described under 2,4-D, except the butyrics should be applied in at least 15 gal of water per acre.

The addition of small quantities of MCPA or 2,4-D to the butyrics increases their effectiveness on mustards and a number of other annual weeds.

CASORON (see DICHLOBENIL)

CHLORAMBEN (AMIBEN)

One of the group of herbicides known as "benzoic acids", chloramben is useful as a preemergence herbicide to control annual grasses and broadleaf weeds, in woody ornamentals and a number of other ornamentals. It is available in both liquid and granular formulations. Satisfactory soil moisture after application is important for its activity. Cocklebur and mustards escape its control. Chloramben has a short residual providing 6 to 8 weeks control after application. Do not apply when crop foliage is wet. This product leaches in heavy rains.

CHLORATE WEED KILLERS (see SOLIUM CHLORATE)

CHLORFLUORENOL (see MAINTAIN)

CHLORPROPHAM (CIPC)

Can be applied to nursery stock. It can also be used as a preemergence spray to control weeds in gladioli. It is available in both emulsifiable concentrate and granular formulations.

The granular formulations of chlorpropham can be applied to the soil surface as a dry application in emerged, established woody nursery stock, and in emerged gladioli. This chemical controls seedling annual weeds and germinating seeds. It is very effective in the control of purslane. It is very effective on seedling

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grasses and chickweed but requires good soil moisture, otherwise it is rapidly lost from the soil surface. It is most effective when applied preemergence or early postemergence to weeds.

CHLORTHAL DIMETHYL (DACTHAL)

For control of crabgrass and other annual grasses and some broadleaf weeds in lawns, some flowers and ornamentals. It is important that it be applied before the weed grass seeds germinate in the spring and therefore, application prior to May 15 on lawns is usually necessary. Fall application is also satisfactory. Control of these grasses may be expected for the remainder of the season. Most turf grasses (with the possible exception of the bents) have good tolerance. Irrigation may be important to ensure activity. Chlorthal dimethyl is available as a wettable powder or in granular formulations. A stable compound, it requires warmth and good soil moisture. It is not effective on rich organic or muck soils.

COMPETOX (see propionics)

CYTROL (see Amino triazole)

DACTHAL (see CHLORTHAL DIMETHYL)

DALAPON (Basfapon)

A soluble powder used for control of quack grass, other grasses, and cattails. This chemical is absorbed through the foliage and roots and is carried throughout the plant. Applications on quack grass in spring or fall are followed by plowing or other cultivation after three days. Heavy treatments of dalapon, as required for quack grass control, may render the soil toxic to a number of crops for about 5 weeks or longer if the soil is cold or dry. If the area is to be sown after treatment, follow manufacturer's directions closely. At high rates dalapon is non-selective;

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but at low rates it controls grasses only. Conditions such as drought and cold that slows growth decreases its effectiveness. Dalapon upsets the enzyme balance of plants and affects protein movement. Since it corrodes iron, aluminum and brass, it should be thoroughly rinsed from equipment after use. It is nonvolatile and non-flammable.

DICAMBA (BANVEL LIQUID HERBIDIDE, DYCLEER)

A member of the group of herbicides known as the benzoic acids. It is particularly useful for the control of field bindweed, smartweed, wild buckwheat and Canada thistle. In mixtures with 2,4-D or 2,4-D + Dichlorprop, it is effective for brush control, especially conifers. Mixtures of2,4-D with low concentrations of dicamba are useful for the control of many broadleaf weeds in lawns. Spray drift is toxic to sensitive plants in the same manner as 2,4-D and similar precautions should be followed. (It translocates in the plant in a manner similar to 2,4-D. Root absorption occurs, but primary action is through the leaves.) At normal rates it breaks down rapidly in soil. At higher rates it can also be toxic to trees and shrubs with roots feeding below the treated area.

DICHLOBENIL (CASORON)

A granular herbicide used to control germinating annual weeds (and many perennial weeds such as thistle) and quack grass in woody, ornamental plantings. It should be applied preferably in the late fall or in early spring to reduce volatility losses encountered under high temperature and dry soil conditions. Split applications made in the fall and spring have been effective in control of quack grass. It is used before weed seedlings emerge or before growth of perennial weeds. Moisture is required to move the chemical into the soil surface. This material should not be applied when temperatures are above 65°F.

2,4-D - Effectiveness, ease of application, low cost, and safety to the operator make 2,4-D the most widely used herbicide in Canada today. With proper application, a wide range of annual, biennial, and perennial weeds may be selectively controlled. It is also effective against many woody plants.

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Unfortunately, some crop and garden plants are as susceptible to 2,4-D as many weeds. Thus, only a trace of this herbicide, either in a spray, dust, or vapor, on a crop like tomatoes or tobacco, may do serious damage.

Even crops that can be sprayed safely may be damaged at certain stages of growth, or by overdoses. Recommendations should be carefully followed.

FORMULATIONS. Ester, low-volatile ester, and amine formulations, are commonly found on the market. The ESTERS are the most active forms of 2,4-D and are usually used at lower rates than other types. They are also more effective against hard-to-kill weeds and brush. As esters of 2,4-D are soluble only in oil, commercial formulations include chemicals which permit the emulsification of the oil carrier in water. They are also the most volatile, hence the most dangerous near susceptible crops. LOW-VOLATILE ESTER formulations reduce the hazard of volatility associated with the regular esters. The AMINES, at recommended rates, are as effective against many weeds and are safer to use on many crops. Amines dissolve readily in water.

VOLATILITY. Since damage to nearby plants may arise from vapors from areas treated with the ester formulations, ONLY THE AMINES SHOULD BE USED ON LAWNS, AROUND GARDENS, OR IN SUSCEPTIBLE CROP AREAS.

ACID EQUIVALENT. Recommendations are on the basis of ounces (weight) of2,4-D acid equivalent. Commercial products differ in their content of acid equivalent and this must be considered in determining the amount of product to use.

Annual weeds are controlled more readily with 2,4-D when they are in the seedling stage. Perennials are more susceptible when there is abundant foliage, or at the early flowering stage. All weeds are more easily killed when growing rapidly in moist soil.

When diluted for use 2,4-D is non-hazardous to man and animals, non-corrosive, and not a fire hazard. Properly applied, it is a safe and efficient herbicide. At recommended dosages, 2,4-D does not remain longer than a few weeks in warm, moist soil.

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2,4-D CAN DAMAGE CROPS

Consider any area near a susceptible crop or any area close to a high value-per-acre crop (resistant or not) as a HIGH-RISK LOCATION.

Reduce the danger from spray drift by using high volumes at low pressures, and spraying only when a light breeze will carry the drift away from susceptible crops. Under windy conditions the operator has no control of the herbicide, and crops at a considerable distance may be damaged.

Never use equipment that has previously applied 2,4-D like chemicals for pest control in susceptible crops. It is nearly impossible to remove the last traces of these chemicals from such equipment.

Never store, handle, or use 2,4-D-like chemicals, or equipment that has applied these chemicals, in a greenhouse, frame, headhouse, or potting shed. Vapors from leaky cans, spilt materials, equipment, or sprayed areas will readily enter greenhouse vents and cause damage.

Remove your "2,4-D clothes" before entering the house (greenhouse, hotel, etc). The vapors may injure house plants. Your wife will not be pleased!

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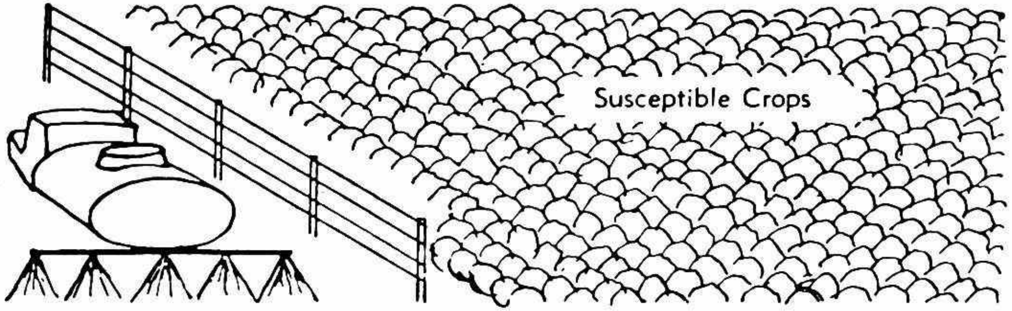
HIGH-RISK LOCATION



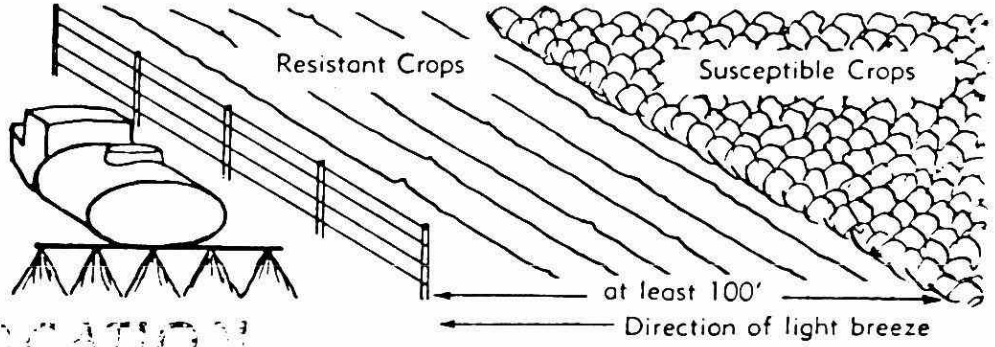
In High-Risk Locations—use other methods of weed control.

High-risk locations are fields, roadsides, or rights-of-way, etc., adjacent to susceptible crops*, gardens, or trees that may be readily damaged by 2,4-D vapor or by spray drift from any herbicide, e.g., tobacco beside a road. If chemicals are used, avoid "over-all" applications. Do not use any form of 2,4-D, MCP, "butyrics", or 2,4,5-T.

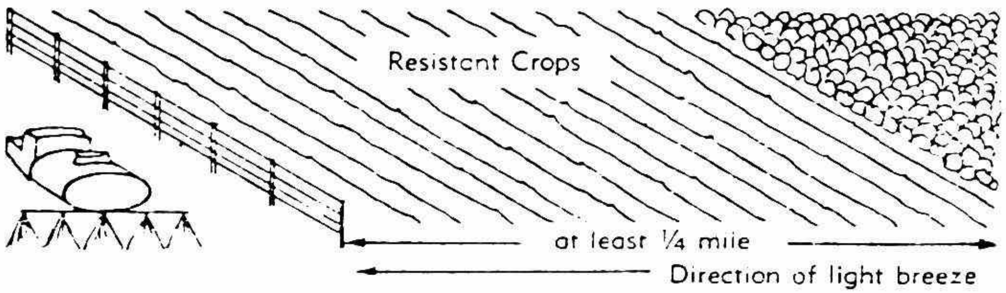
MEDIUM-RISK LOCATION

In Medium-Risk Locations—If herbicides are employed, use amine or low-volatile ester forms of 2,4-D and of 2, 4, 5-T, or use another chemical.

Medium-risk locations are those where susceptible crops* are some distance upwind from the area to be sprayed and out of range of normal spray drift, or where the operator has complete control of the spray as with hand equipment in spraying lawns and gardens.



LOW-RISK LOCATION



In Low-Risk Locations—use standard chemical weed control practices.

Low-risk areas are those where susceptible crops* lie at least ¼ mile upwind from the treated area.

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*Grapes, tomatoes, tobacco, sugar beets, beans, turnips, cauliflower, cabbage are examples of crops that are very sensitive to 2,4-D and similar compounds. Moreover, many other crops like fruit trees may be susceptible to these chemicals at certain stages of development—particularly during bud differentiation and flowering.

~~Prepared by C. B. Kelly and R. O. Bibbey~~
~~Department of Botany, Ontario Agricultural College, Guelph~~

2,4-D/CHLORATE MIXTURES

Mixtures of 2,4-D amine and chlorates, prepared as recommended, give excellent control of roadside weeds and brush at reasonable cost. Such mixtures are low volatile and are, therefore, somewhat safer to use in areas where crops susceptible to 2,4-D are grown. Either sodium chlorate or the chlorate mixtures may be used.

> CAUTION - When mixing 2,4-D with other chemicals, bring one of the chemicals to field dilution before adding the other

DICHLORPROP

Dichlorprop is the common name for 2,4-D propionic acid. It is more effective in the control of certain weeds such as chickweed, wild buckwheat and smartweed than regular 2,4-D acetic acid. Dichlorprop-2,4-D mixture is available as a low-volatile ester. It is labeled for use on wheat and barley but should not be used for oats. Dichlorprop-2,4-D mixtures are also useful for deciduous brush control and can be combined with either paraquat or dicamba for the control of conifers.

2,4,5-T - The chemical 2,4,5-T is more effective than 2,4-D for the basal-bark treatment of most woody species, for the overall spray of brambles and a number of trees and, in combination with 2,4-D, for the control of certain weeds. Crops such as raspberries and strawberries, that are members of the rose family, are very susceptible to this chemical.

The nature and application of 2,4,5-T are similar to those of 2,4-D, described above.

2,4-D/2,4,5-T MIXTURES - Usually marketed as a 1:1 ratio of 2,4-D to 2,4,5-T, this mixture combines the effectiveness of the two chemicals and kills a greater variety of weeds and brush than either chemical alone. Recommendations are on the basis of the acid equivalent of the combined chemicals.

2,4-DB (see BUTYRICS)

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DIQUAT (REGLONE)

A liquid herbicide that is absorbed through leaves of plants and gives a rapid kill of the leaves contacted but is quickly inactivated by absorption onto soil particles. It is useful for the rapid removal of foliage to establish a bare soil area. Diquat must be used with clean (non-turbid) water as the soil particles in muddy water drastically reduce the effectivensss of the material. It is translocated in plants to some extent but it's action is too rapid to allow much translocation in perennials.

DIURON (KARMEX)

Diuron is a substituted urea sold as a wettable powder. At higher rates it is an effective soil sterilant with a good degree of persistence.

This substituted urea is available as a wettable powder. When applied as a spray, continuous agitation is necessary. (See notes on agitation under "Equipment.") Duiron is not volatile, corrosive, nor is it a fire hazard. It is also low in toxicity to man and livestock.

Diuron should NOT be used where it is likely to leach or wash into contact with the roots of desirable trees or shrubs. Diruon requires moisture to move the chemical into the roots. Dandelious are resistant.

DOWPON (see DALAPON)

DYCLEER (see Dicamba)

EKKO (see Simazine)

FENOPORP (SILVEX)

Fenoprop is a 2,4-D-like chemical that is effective on clovers, black medick, chickweeds and a number of other lawn weeds, brush and poison-ivy. It has low mammalian toxicity and is non-corrosive to metals.

GESAGARD (see PROMETRYNE)

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GLYPHOSATE (ROUNDUP)

A water-soluble herbicide controlling quack grass before planting turfgrass. It can be used for controlling perennial weeds in industrial and non-crop areas including cattails in dry ditches. For site preparation before planting nursery stock, it should be applied when the weeds are actively growing and fully emerged. Treat bindweed when in full flower and milkweed at the bud stage. This herbicide is absorbed through the leaves and green stem tissues and translocated to underground roots or rhizomes of perennial weeds. There is no residual activity in the soil. Rain within 6 hours of application may reduce its effectiveness. Tillage should be delayed for 5 days or more after application to allow sufficient movement of the chemical to the underground parts of the perennial weed.

GRAMAXONE (see Paraquat)

GRO - TARD (see Maleic hydrozide)

HYVAR (see Bromacil)

KARBUTYLATE (TANDEX)

A soil active substituted urea herbicide of low solubility. At proper rates, it controls all annual and perennial weeds except dandelion. Its long residual effect makes it suitable for general vegetation control or soil sterilization, however, it should not be used where it is likely to leach, wash, or move with eroded soil into contact with the roots of desirable trees and shrubs.

KARMEX (see Diuron)

KERB (see Pronamide)

KILLEX 2,4-D and mecoprop and dicamba

KIL - MOR 2,4-D, mecoprop & dicamba

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KRENITE

Krenite effectively controls a number of woody species including oaks, ash, hickory, maple and alder. Cedar and white spruce are quite tolerant. Pine can be effectively controlled in spring if a surfactant is added. Thorough coverage is essential. Woody plants treated with Krenite die very slowly. The stems may not yet be completely killed 2 years after treatment.

- ChorFlurenol

Maintain CF 125 is a growth regulator recommended for reducing grass growth in areas where regular mowing and trimming are difficult - near fences, rough areas of golf courses, rights-of-way and steep banks. Some common weeds (dandelions) are also controlled. This material also retards growth of a number of herbaceous and woody species. The product is non-corrosive and stable. It penetrates foliage and translocates rapidly.

KROVAR (see bromacil and diuron)

MALEIC HYDRAZIDE (MH)

Acts by reducing or inhibiting shoot growth. It controls the growth of grass around sidewalks and curbs. It is also used to control the growth of grass and reduce the number of mowings on roadsides, parks and industrial areas, etc. It is generally non-corrosive, relatively non-toxic to annuals and leaves little soil residue.

MCPB (see BUTYRICS)

MCPP (see PROPIONICS)

MECOPROP (see PROPIONICS)

METAM-SODIUM (VAPAM)

This chemical is a liquid that is applied as a preplanting soil drench or by soil injection to seedbeds, etc., for the control of annual and perennial weeds, certain plant diseases, nematodes, and insects. While the chemical acts by vaporizing in the soil, no gas-proof cover is required unless the soil is very porous. A sprinkler application of water should be used to provide a surface

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"water seal". Planting may take place 12 to 16 days after the treatment. Do not use in greenhouses or other confined spaces. The chemical is poisonous and irritating to eyes, nose, throat and skin. Since this chemical requires moderate soil temperature and proper moisture conditions, read the directions carefully before use.

MONURON (see DIURON)

NALCO-TROL/LO-DRIFT

A polyvinyl polymer which when added to water sprays, reduces spray drift by increasing the droplet size and by reducing the numbers of fine spray droplets.

NORBAK-60

A water-swellable plastic polymer which is used to particulate herbicide spray solutions and reduce spray drift.

OILS - NONSELECTIVE

Nonselective petroleum oils alone or in combination with pentachlorophenol, or dinitros, as contact herbicides kill leaves, etc., on which they are sprayed.

PARAQUAT (GRAMOXONE)

A water-soluble herbicide which is absorbed rapidly through the leaves. It is particularly recommended for chemical mowing on drainage ditch banks, on garden paths, and around the base of trees. The chemical is translocated to some extent within both grass and broadleaf weeds but is quickly inactivated by absorption onto soil particles. Plants must be well covered with the spray for a good "burn off". Paraquat works best under conditions of low light intensity and high humidity. For best results apply on a dull day or in the evening. This chemical may be fatal if swallowed. Prevent skin or eye contact by wearing rubber gloves and eye goggles or eye shield when handling. It may be combined with other chemicals for residual control. Paraquat is somewhat more corrosive than diquat especially at high concentrations and equipment should be

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thoroughly cleaned after use. Avoid any intake by mouth or breathing of fine mists of the spray solution. The chemical has no known antidote. The lung is the primary organ affected.

PARAQUAT-DIQUAT MIXTURE (WEEDRITE, WEEDBAN)

A commercial formulation sold for homeowner use as a "chemical mower" to control weeds on driveways, pathways, and other non-cultivated areas. It is applied in water with a watering can, dribble bar, or low pressure sprayer to wet the leaves of both grass and broadleaf weeds.

Avoid contact with leaves and green bark of desirable shrubs and other garden plants. For best results apply on a dull day, or in the evening, as it is more effective under conditions of low light intensity and high humidity.

PARAQUAT/DIRUON (TOTA-COL)

A commercial mixture prepared as a liquid suspension for use on non-crop land. Better results are obtained if applications are made on a dull or cloudy day or in the evening. This mixture provides residual control of seedling weeds.

PARAQUAT/SIMAZINE (TERRAKLENE)

A commercial mixture prepared as a liquid suspension for use under woody ornamentals. Better results follow its use on a dull or cloudy day or in the evening. This mixture is designed to give rapid kill of emerged weeds through contact action and residual control of germinating weeds.

PICLORAM (TORDON)

A herbicide that has been shown to be highly active for the control of certain species of woody plants and broadleaf weeds. It may persist in the soil for a number of years and has killed or caused considerable damage to nearby plants. Therefore, it must NOT be applied on land used, or that may be used, for the production of agricultural crops. Also, it must NOT be applied over or near areas where roots of desirable trees or other plants may extend into the soil, or where the chemical may be washed or otherwise moved into contact with the roots.

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There are two liquid and two dry formulations available. The liquid formulations are known as Tordon 22K and Tordon 101 Mixture with 2,4-D and the dry formulations are Tordon 10K Pellets and Tordon Beads.

These materials should only be used at the rates and under the conditions specified, and following the precautions listed by the manufacturer on the label. Because of the high activity of this herbicide and the probability of damage if used incorrectly, a permit for its use is required from the Ontario Ministry of the Environment. No recommendation is made for its use by the general public.

It is effective on hard to eradicate woody species such as conifers, vine maple and perennial weeds such as field bindweed and Canada thistle. Grasses are quite tolerant. Picloram is absorbed by foliage and roots and translocated. It will break down in clear water by sunshine and is degraded in warm moist soil having a good organic matter content. It is persistent in dry cold soils and in soils low in organic content. Some leaching may occur in sandy soils. It is non-corrosive and non-flammable.

PRINCEP (see SIMAZINE)

PROMETONE

A substituted triazine with relatively long persistence in the soil and little crop selectivity. It is used for vegetation control on non-crop land. Available as an emulsifiable concentrate, prometone can be absorbed by weeds through roots and foliage. For the best results application should be made early in the season before growth is well developed. Prometone is non-corrosive, non-flammable and low in mammalian toxicity. Prometone should not be used in situations where it could leach, wash or erode with treated soil into contact with desirable plants.

PROMETRYNE (GESAGARD)

A substituted triazine which can be absorbed by weeds through the root system and through foliage. It can be applied preemergence or on weeds up to 2 to 3 inches high. Adequate moisture is required

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for satisfactory weed kill after preemergence application. Prometryne is available as a wettable powder and should be thoroughly agitated to keep it in suspension in the spray tank. It is low in mammalian toxicity and is non-corrosive. Persistence in the soil is much less than that of atrazine or simazine, usually remaining one to three months. It is non-flammable.

PRONAMIDE (KERB)

A wettable powder which may be used to control quack grass, blue-grass, orchard grass, and other perennial grasses. Common chickweed is also controlled but it will not control dandelions, thistle, bindweed and most deep-rooted perennial weeds. Kerb should be applied in September or October with best results when soil temperatures are low and sufficient time is allowed before ground freeze for penetration into the soil. The herbicide is absorbed through the roots, and it is therefore most effectively applied when the soil moisture supply is high, and rain or an overhead sprinkler irrigation follows application. Wait 9 months before planting other crops in Kerb-treated soil.

PROPIONICS (Mecoprop - Fenoprop - Silvex)

These are a series of chemicals similar to the 2,4-D and MCP "acetic" acids. Thus we have 2,4,5-T propionic acid (fenoprop) and MCP propionic acid (mecoprop) on the market. The formulations, such as salts and esters, and the uses of these chemicals, are similar to those described earlier under 2,4-D.

The propionics are particularly effective against chickweeds, clovers, and a number of other lawn weeds. Mixtures of propionics with 2,4-D allow the ready control of most of the weeds found in lawns.

Fenoprop may be used where 2,4,5-T is less effective, e. g., on poison oak and other weedy species or in clover in turf. Mecoprop is used on turffor clover and for many persistent weeds. It appears to be safer on bent grass than 2,4-D provided cold weather and drought periods are avoided.

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REGLONE (see DIQUAT)

ROUNDUP (see GLYPHOSATE)

SIDURON (TUPERSAN)

A selective preemergence crabgrass herbicide for use on established turf, with the exception of Washington Bent. It is available as a wettable powder and in mixtures with fertilizers. It has shown promise for use on new grass plantings also, as it apparently is not toxic to most species of turf grasses. It does not control broadleaf weeds, annual blue grass or clover.

SILVEX (see PROPIONICS)
SIMAZINE (see PRINCEP, SIMAPRIM)

Simazine can be used for weed control in woody nursery stock, and in noncrop areas. It is relatively insoluble in water and persists for long periods in the soil. Extreme caution is needed if simazine is used in a rotation where susceptible crops may be grown one year after application. It is not foliar absorbed but works through root absorption. It will not leach readily and breaks down slowly in soil.

SLO-GRO (see MALEIC HYDRAZIDE)

SODIUM CHLORATE (ATLACIDE)

A nonselective herbicide. At low rates it acts as a chemical mower to burn off all foliage, but grasses will regrow in a few weeks. At higher rates, the soil will be sterile for one or more years. The use areas are locations where dead vegetation and soil sterility do not cause problems, or locations where these results are acceptable or desirable.

Sodium chlorate is very corrosive to metals. Little harm is done to wire fences, but it is wise to direct the spray away from ornamental fences. All equipment should be thoroughly washed after use.

> The use of solium chlorate may constitute a serious fire hazard, as well as a potential source of livestock poisoning. The chemical may be applied safely, however, if used with care and with strict adherence to the precautions outlined below.

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POISONOUS PROPERTIES Chlorate weed killers are poisonous to livestock when taken in relatively large amounts. Do not use as a soil sterilant in pastures where livestock are likely to have access to the treated areas within three months. Keep animals well supplied with salt.

FIRE HAZARD Sodium chlorate, and particularly mixtures of sodium chlorate with organic matter, constitute a serious fire hazard when dry.

(1) Use mixtures of sodium chlorate and chemicals with fire-retardant properties.
(2) Never open containers of sodium chlorate in a building.
(3) Never allow clothing moistened with chlorate to dry on the body. The slightest friction may cause a serious blaze. Wear rubber boots and wash both boots and clothing after using.
(4) Treated areas are highly inflammable. Avoid driving equipment or walking through such areas after a rain.
(5) Mix sodium chlorate with other chemicals only in water.
(6) When working with sodium chlorate herbicides do not smoke until away from treated area and your clothes have been changed.
(7) Store sodium chlorate in a shed away from other buildings.

SODIUM TCA (see TCA)

SPIKE (see TEBUTHIURON)

TANDEX (see KARBUTYLATE)

TBA

Trichlorobenzoic acid is a nonselective liquid herbicide for the control of certain deep rooted perennials such as leafy spurge, field bindweed, Canada thistle and evergreens. It is absorbed through both foliage and roots. Residue in the soil may injure soy or white beans for several years. Grasses will be first to recover. Spray drift and possible vapors may injure 2,4-D susceptible crops nearby. Check label carefully before using on cropland.

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TCA (SODIUM TCA)

Effective for the control of evergreen brush in non-cropped areas and can be mixed with 2,4-D/2,4,5-T for combined control of deciduous brush. The chemical may irritate the skin and eyes and will cause burns on prolonged contact. Like dalapon it is a grass killer absorbed by leaves and roots. At high rates TCA appears to inhibit germination. TCA disappears from soil in about three months under warm, moist conditions and leaches readily. It may last longer in soils with high organic matter or under cool, dry conditions. It is somewhat corrosive and equipment should be cleaned after use.

TEBUTHIURON (SPIKE)

A nonselective soil active, substituted urea herbicide. When applied at rates of 5 and 10 lb/acre, effective total vegetation control can be achieved for 2 or 3 years, respectively. Some weeds such as horsetail may not be controlled by the lower rate. Since Spike is nonselective, it should not be applied to soil areas penetrated by roots of desirable plants, or to areas where the chemical could move by washing with heavy rains or eroded soil into contact with desirable plants.

TERRAKLENE (see PARAQUAT/SIMAZINE)

THIAZFLURON (ERBOTAN)

A nonselective soil active, substituted urea herbicide. When applied at rates of 5 or 10 pounds per acre, effective total vegetation control can be achieved for one or two years respectively. Some weeds such as horsetail or field bindweed may require more than one treatment to get effective control. Since Erbotan is nonselective, it should not be applied to soil areas penetrated by roots of desirable plants or to areas where the chemical could move by washing with heavy rains or eroded soil into contact with desirable plants.

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TORDON (see PICLORAM)

TOTA-COL (see PARAQUAT/DIURON)

TREFLAN (see TRIFLURALIN)

2,4,5-TP (see SILVEX)

TRIFLURALIN (TREFLAN)

Available as an emulsifiable concentrate and in granular formulations. It is used as a preplant incorporated treatment on ornamentals. Trifluralin is most effective on annual grasses, but will control most of the common annual broadleaf weeds except ragweed, mustards, black nightshade, and velvetleaf.

Trifluralin is slightly volatile, it gradually degraded in sunlight, and for maximum herbicidal action it should be incorporated into the soil immediately after spraying. The incorporation implement should be operating at a depth of 3 to 4 inches and used so that it breaks up large clods and mixes the soil thoroughly and uniformly. It has low solubility and has a soil persistence of 12 months in dry land. It is of low toxicity but fish may be affected.

TUPERSAN (see SIDURON)

VAPAM (see METAM-SOLIUM)

VORLEX

A soil fumigant used for sterilization of plant propagation beds, nursery soils, turf areas, and as a preplant greenhouse. The liquid is injected into the prepared soil with special applicators and the soil is sealed immediately by rolling or packing. A number of soil-borne diseases, nematodes, weed seeds, and some insect pests can be controlled.

Vorlex is a mixture of methylisothiocyanate, dichloropropene, and related chlorinated hydrocarbons.

Its effectivensss is reduced in heavy clay, but it works well

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in light mineral soils. For weed control it is injected 4 to 6 inches into the soil and the soil is then firmly packed or floated. It is most active in warm, moist soils and is effective against the seeds of many broadleafed and grassy species. It is corrosive at room temperature especially to aluminum-alloy containers, and equipment should be flushed after use. It is moderately toxic but causes considerable irritation to eyes, nose, throat and skin. Therefore, avoid vapours.

The Ontario Ministry of Agriculture and Food annually produces an informative booklet entitled "Guide to Chemical Weed Control". This publication contains the latest recommendations with regard to herbicide usage in Ontario. While the entire publication contains some useful information, some sections are of particular importance to persons applying herbicides to non-agricultural land. These sections are quoted directly in the following section.

PASTURES (Mostly Grasses)

Weed control in grass pastures requires the maintenance of a vigorous, dense grass stand by the use of many good management practices including control of fertility and grazing. The application of fertilizers will stimulate the grass and help control weeds such as hawkweeds and ox-eye daisy. Overgrazing tends to thin the grass stand and allows the establishment of weeds. Under-grazing allows weeds like wild carrot to form and spread seed. Timely mowing can prevent the ripening of weed seeds and reduce the distance these seeds spread with the wind.

Chemicals are available to control most of the troublesome weeds in grass pastures and these can give faster kill of established weeds than any other management practice. A chemical may have to be applied more than once to kill established perennial weeds and the new crop of weeds emerges through a thin grass stand. A poor grass stand can be improved by using a combination of chemicals, fertility and grazing management.

Chemical weed control should extend into fencerows and other areas around the pasture to keep these areas from becoming sources of weed seeds.

Generally, clovers are severely damaged by chemical treatments. However, wild white clover and black medick show some resistance or reestablish quickly.

Keep livestock out of the field for 5 days after spraying to avoid chemical residues in the animals and animal products.

Care should be taken to prevent grazing where poisonous plants (water hemlock, chokecherry, etc.) may be made more attractive to livestock after the chemical treatment. It is a good practice to prevent grazing on the field for at least a week after spraying to reduce the chances of the livestock picking up harmful plants.

The following list indicates chemical methods of control for specified weeds. The chemical and method of application should be selected to control the most troublesome weed in the field. Apply chemical treatments in at least 20 gal of water per acre and increase this rate if it is necessary to contact weeds through a thick volume of vegetation.

BLUEWEED – Late spring or early fall application of 16 oz 2,4-D acid as low-volatile ester per acre.

BRUSH – See pages 88 to 92.

BURDOCK – 2,4-D 16 oz as low-volatile ester per acre applied either in fall or spring. This treatment is most effective on first-year rosettes.

BUTTERCUP – 16 oz MCPA acid as low-volatile ester applied per acre in June and again early in September.

CANADA THISTLE – (1) DICAMBA (BANVEL) 8 oz acid per acre. Apply in late spring.

(2) MCPB and MCPA (15:1) mixture 24 oz acid as sodium salts applied in late spring. This treatment could be used if some legumes are present in the field.

(3) 2,4-D 16 oz to 24 oz acid as low-volatile ester per acre applied in late spring. More than one treatment with these chemicals will be necessary for eradication.

CHICORY – 2,4-D 12 oz acid per acre applied in late spring.

DANDELIONS – 2,4-D 12 to 16 oz acid per acre applied in either late spring or early fall.

FIELD BINDWEED – (1) DICAMBA (BANVEL) 8 oz acid per acre. Apply in mid-June when flowering.

(2) 2,4-D or 2,4-DB 16 oz acid per acre applied in mid-June when flowering, and repeated in early September.

GOAT'S-BEARD – 2,4-D 12 to 16 oz acid as low-volatile ester, as early as possible on second year's growth, or early fall on first year's growth.

GOLDENROD – 2,4-D/2,4,5-T, 16 oz acid per acre applied in June.

HAWKWEEDS – 2,4-D 16 to 24 oz acid as low-volatile ester applied near the end of May and early September.

LEAFY SPURGE – (1) TBA (BENZAC or TRYSBEN 200) 10 to 20 lb acid equivalent in 100 gal water per acre or ¼ to ½ lb acid equivalent per 1000 sq ft. Apply to young growth. Residues may damage crops for a number of years.

(2) 2,4-D or 2,4-D/2,4,5-T mixtures 16 to 24 oz acid as low-volatile ester per acre, or if legumes are present 2,4-DB 20 oz acid per acre. Repeated treatments will be necessary.

MILKWEED – (1) AMITROLE or AMITROLE T 4 lb active in 50 gal water. Spray to wet before flowering. Use spot treatments because chemical will damage grasses. Keep animals away from treated area for 6 to 8 months following AMITROLE or AMITROLE T application. September application can be made if the weed foliage is actively growing.

(2) 2,4-D/2,4,5-T 16 oz mixture acid as low-volatile ester per acre as a late spring application emphasizing spraying of undersurface of leaves. This treatment kills the top growth only.

MULLEIN – 2,4-D/2,4,5-T mixture 16 oz per acre applied in June or September to kill young plants only.

NODDING, BULL AND SCOTCH THISTLE – Late spring or early fall application of 16 oz 2,4-D or 2,4-DB acid per acre.

OX-EYE DAISY – Two treatments, one in mid-June the second in early September if there is sufficient growth, with 16 to 24 oz 2,4-D acid per acre.

RAGWORT – 2,4-D 32 oz acid as amine or low-volatile ester on rosettes in spring and fall. Retreatments will be necessary to control any new seedlings and regrowth.

WATER-HEMLOCK – 2,4-D/2,4,5-T mixture 16 oz per acre applied in May or June.

WILD CARROT – Early fall treatment of first-year plants, or spring treatment of second-year plants with 16 oz acid per acre of either 2,4-D, or, if the plants appear resistant to 2,4-D, use 2,4-D/2,4,5-T mixture.

YELLOW ROCKET (WINTER CRESS) – 12 to 16 oz 2,4-D acid in September or October or in early spring to control old plants and seedlings. Applications after the flowers appear are largely ineffective, although they may reduce seed production. Mowing is a better method of handling yellow rocket at the flowering stage.

FOR MORE INFORMATION ABOUT THE SUSCEPTIBILITY OF WEEDS TO THESE CHEMICALS SEE TABLE 7, PAGE 95 to 96.

HORTICULTURAL CROPS

The use of chemicals for the control of weeds in horticultural crops is increasing. High labor costs, a chronic shortage of help when most needed, and more experience with the recommended herbicides are reasons for the adoption of chemical methods of weed control.

Many horticultural crops are damaged by some of our common herbicides. Sprayers that have been used for hormone-type (2,4-D etc.) chemicals SHOULD NOT BE USED for applying insecticides, fungicides, or herbicides on susceptible horticultural crops.

The treatments listed in this publication are based on extensive field trials and observations on farms. **Herbicides should not be used in cold frames or greenhouses unless specifically recommended.**

The higher value per acre of most horticultural crops compared with field crops sometimes justifies the use of more expensive chemicals. An attempt has been made to recommend the most effective and most economical treatments. Their correct use should result in savings in cultivation, hand weeding, and other costs. Sometimes weeds escape a chemical treatment and cultivation is necessary. Such weeds should be considered an escape when they reach the 3- to 4-leaf stage.

It is difficult to control quack grass, field bindweed, horsetail and similar perennial weeds in crops such as asparagus, strawberries, raspberries, etc, which occupy the same area for a period of years. Perennial weeds of this type should be eradicated or brought under control before these crops are planted. (See pages 84 to 89.)

The recommendations for some of the horticultural crops, such as snap beans, peas, and sweet corn will be found in the field crops section because they are similar to those for field beans, peas, and field corn. Differences have been noted where necessary.

WEED CONTROL IN GARDENS

It is usually not possible to recommend the use of herbicides in gardens because many garden plants can be killed or damaged by the chemicals used to kill weeds. The frequent use of a hoe, or other shallow cultivation, is the most practical method of controlling weeds in gardens. Most annual weeds can be killed with one or two cultivations. Perennial weeds can be killed by any kind of cultivation which removes all top growth at frequent intervals. After the food stored in the roots has been used, the weeds will die.

The herbicides listed under each crop are available for farm, custom spraying, and industrial use. **The Ontario Pesticides Act 1973 restricts the sale of herbicides to the home gardener to those with a domestic label.** These are:

Common name		**Example of Product**
chloramben	–	Garden Weeder, Ornamental Weeder
chlorthal dimethyl	–	Dacthal
EPTC	–	Eptam, Weed Preventer
paraquat/diquat mixtures	–	soluble granules, aerosols
trifluralin	–	fertilizer mixtures, Weed Preventer
various crabgrass control chemicals		Betasan, Dacthal, & trifluralin/fertilizer mixtures
2,4-D	–	Lawn Weed Killer, fertilizer mixtures

When it is possible to apply the chemical to one kind of garden plant, without danger of spray or dust drifting onto susceptible garden plants, one of the chemicals recommended in this book may be used (Check list above.) Granular formulations can be applied using a jam jar with a perforated top. This "salt shaker" method, after a little practice, is effective and quick. A small compressed air sprayer can be used to apply any liquid or wettable powder which is mixed in water. It is important that the correct amount be applied. One way of ensuring accuracy is to fill the garden sprayer with water to a mark – apply the spray of water to 1000 sq ft taking care to apply it as evenly as possible, and then measure the amount of water used. Add the chemical recommended in the bulletin to this amount of water for each 1000 sq ft treated.

As a guide in converting the recommended rate per acre of any chemical to the amount required for a small area, 1 oz per 1000 sq ft is approximately equal to 3 lb per acre. For liquid measure, 2 level tbsp is approximately 1 fl oz. One pint, or 20 fl oz of spray mixtures per 1000 sq ft is equal to the 5-gal-per-acre rate.

OTHER HORTICULTURAL USES

ANNUAL FLOWERS

WEEDS	TREATMENT
Seedling annuals and germinating seeds	**CHLORAMBEN (ORNAMENTAL WEEDER, WEEDONE GARDEN WEEDER), 4 lb (active) per acre. Granular, preemergence to weeds.** **CHLORTHAL DIMETHYL (DACTHAL), 8 to 15 lb (product) in 30 gal water per acre. Preemergence to weeds.** **EPTC (EPTAM), 3 to 5 lb (active) per acre in 30 gal water. Preplant incorporated on mineral soils only prior to transplanting.** **TRIFLURALIN (TREFLAN), ½ to 1 lb (active) per acre. Preplant incorporated for transplants only.**

CHLORAMBEN is applied as a granular formulation on weed-free areas about established plants. Check label for list of tolerant plants.

CHLORTHAL DIMETHYL will provide control of annual grasses and a number of broadleaf annuals when applied before weed emergence. Use only on established transplants.

EPTC must be thoroughly incorporated before transplanting. Use on mineral soils only. Do not use for seeded annual flowers. For use after the plants are established apply the granular formulation, at the lower rate, when the leaves are dry and use sprinkler irrigation to incorporate.

TRIFLURALIN must be incorporated thoroughly, before transplanting, to a depth of 3 to 4 inches. Do not use for seeded annual flowers. Check label for list of tolerant species.

DRIVEWAYS, PATIOS AND PATHS

WEEDS	TREATMENT
Many broadleaf weeds and grass	**PARAQUAT (GRAMOXONE), ½ to 1 lb (active) per acre in 25 or more gal water, or 1 fl oz (product) in 2 gal water per 1000 sq ft.** **PARAQUAT + DIQUAT MIXTURE (WEEDRITE or WEED-BAN), 4 tbsp in 1 to 2 gal water per 200 sq ft.** **AMMONIUM SULFAMATE (AMMATE X), ⅔ lb (product) per gal water. Spray to wet weed foliage.**

AMMONIUM SULFAMATE is not selective, that is, it will kill all grass and broadleaf weeds on which it is sprayed. Wash all spray equipment immediately after use as this chemical is very corrosive.

PARAQUAT, as GRAMOXONE, is not available for sale to the homeowner but can be used by nursery-men, landscape contractors and farmers. It should be applied as a directed spray to wet the leaves of weeds. Avoid contact with leaves or green bark of shrubs and other garden plants. Better results are usually obtained if application is made on a dull or cloudy day, or during the evening.

The PARAQUAT + DIQUAT MIXTURE is packaged in small quantities for the home garden trade. It is useful as a "chemical mower" and will not leave a harmful residue in the soil. It can be applied using the lower volume of water with a small knapsack or garden sprayer. Keep the pressure low and use a coarse spray to prevent drift onto lawns, flowers, vegetables, and green leaves of bulbs and other desirable plants. The larger volume of water is necessary when a watering can or dribble bar is used to apply the mixture. Apply in the evening or on a dull or cloudy day.

LAWNS, PARKS and GOLF COURSES

WEEDS	TREATMENT
	Postemergence
Dandelions, plantains and many broadleaf weeds	2,4-D AMINE, 16 oz acid in 10 to 20 gal water per acre, or 1 oz to 4 gal water per 2500 sq ft.
Chickweeds, clovers, black medick, and other 2,4-D resistant weeds, including knotweed when young	MECOPROP (MCPP), 16 oz (active) in 40 gal water per acre or 1 oz (active) in 5 gal water per 2,500 sq ft.
Most broadleaf weeds	2,4-D/MECOPROP, 2,4-D/DICAMBA, 2,4-D/DICHLORPROP, 2,4-D/FENOPROP/DICAMBA, 2,4-D/MECOPROP/DICAMBA, mixtures may be used to control most broadleaf weeds that infest turf areas. Follow manufacturers' directions.
Crabgrass	**Preemergence on established turfgrass**
	BENSULIDE (BETASAN), 12 to 15 lb (active) per acre. Liquid or granular. Follow manufacturer's directions. (Apply early spring or in the fall.)
	CHLORTHAL DIMETHYL (DACTHAL), 10 to 15 lb (active) per acre. Use the higher rate for fall applications. Follow manufacturer's directions. (Apply early spring or in the fall.)
	SIDURON 8 to 12 lb (active) per acre on established turf. (Apply only in early spring.)
	TRIFLURALIN, 1.5 to 2 lb (active) per acre. Follow manufacturer's directions. (Apply only in early spring.)
	Preemergence on newly seeded turfgrass
	SIDURON, 6 lb (active) per acre applied after seeding but preemergence to the crabgrass seedlings.
Annual bluegrass (Poa annua)	BENSULIDE (BETASAN), 12 to 15 lb (active) per acre. Follow manufacturer's directions.
	CHLORTHAL DIMETHYL (DACTHAL), 10 to 15 lb (active) per acre. Follow manufacturer's directions.

WARNING – Do not use 2,4-D, FENOPROP or DICAMBA on bent grass or newly seeded lawns.

WARNING – Since lawns are generally associated with a wide range of ornamentals, flowers, etc that are susceptible to 2,4-D, FENOPROP, DICHLORPROP, DICAMBA or MECOPROP, particular care must be taken in the application of these chemicals.

Vigorous growth of an adapted grass is the key to keeping lawn areas free of weeds. Proper lawn maintenance with the application of fertilizers is essential. The reader is referred to publications on this subject from both Agriculture Canada and the Ontario Ministry of Agriculture and Food.

Where dandelions, plantains and other broadleaf weeds are present, 2,4-D as described above may be used. The spray is most effective in the spring, or in September when the weeds are growing well. The treatment will generally thin Dutch clover in the lawn. Where 2,4-D resistant weeds such as chickweeds, clovers, and black medick are also troublesome, 2,4-D/MECOPROP, 2,4-D/DICHLORPROP, 2,4-D/FENOPROP or 2,4-D/MECOPROP/DICAMBA mixtures are recommended.

MECOPROP, DICHLORPROP, FENOPROP and DICAMBA will control a number of weeds resistant to 2,4-D. As with 2,4-D, a thorough wetting of the weed foliage is emphasized. MECOPROP, DICHLORPROP and DICAMBA are also sold in mixtures with 2,4-D. MECOPROP is safer to use on bent grass than either FENOPROP or 2,4-D.

Mixtures containing DICAMBA **should not be used close to shrubs**, etc, at rates above 6 oz active per acre. Prepared mixtures of this chemical and 2,4-D are effective on a wide range of lawn weed species, including knotweed which is resistant to most other herbicides except when very young. After seeding new turf, many annual weeds may emerge before the grass seedlings are up. If these young weeds are not controlled they will shade and eventually crowd out much of the grass population. Mowing with the mower set to cut as high as possible will eliminate many such weeds. If they are extremely thick, 2,4-D at one-half the usual rate (1 oz active in 8 gal of water per 2500 sq ft) or mecoprop (1 oz active in 4 gal per 2500 sq ft) can be used but not before the grass has been up at least 4 weeks.

Crabgrass may be controlled in a newly seeded area by applying SIDURON (TUPERSAN) at 6 lb (active) per acre. This chemical must be applied after seeding but pre-emergence to the crabgrass seedlings. DO NOT apply other preemergence herbicides to new seedlings.

BENSULIDE, CHLORTHAL DIMETHYL, SIDURON and TRIFLURALIN are applied before the emergence of crabgrass seedlings. In most years this means an application about May 1 or not later than May 15. Where a lawn was infested with crabgrass the previous year, spring treatment with one of these chemicals is recommended. BENSULIDE or CHLORTHAL DIMETHYL treatments may also be applied in the fall as sufficient chemical remains in the soil to control crabgrass the following summer. None of these chemicals is effective against established crabgrass.

A number of mixtures containing both FERTILIZER and a HERBICIDE are available for use on lawns. They are convenient to use and are effective when used as directed. The application must be made at the time required for effective weed control and the mixture must be applied evenly over the area. Use a fertilizer spreader for best results and apply half the material in one direction and the other half at right angles. Particular care should be taken when using a cyclone-type rotary spreader to avoid spreading the material on nearby flowers and shrubs.

TURFGRASS RENOVATION

The turf to be renovated should be mowed and thoroughly raked to remove all dead and cut vegetation. Apply PARAQUAT (GRAMOXONE) at the rate of 1 gal product (2 lb active) in 100 gal water. For smaller areas use 4 fl oz of product in 2 gal water per 1000 sq ft. This treatment will "burn off" all emerged vegetation. When the old turf is dead, rotovate the top 2 inches to cover dead grass, rake the surface to prepare seedbed and reseed.

Glyphosate (ROUNDUP) at 1.5 to 2 lb (active) per acre in 20 to 30 gal of water after omitting at least one regular mowing. Tillage should be delayed 7 days after application to allow for proper translocation into underground plant parts.

TURFGRASS RETARDATION

Reduction in grass growth may be brought about by treatment with MALEIC HYDRAZIDE (SLOGRO) or with MAINTAIN CF125 or by using a mixture of the two compounds. Manufacturers' directions should be followed carefully.

These chemicals are recommended for use in areas where mowing and trimming are difficult and where a lawn-like appearance is not necessary. Temporary discoloration may result. Thus, the chemicals are recommended primarily for rough areas on golf courses, along fences or on steep banks. They are NOT recommended for use on home lawns.

Treatments should be applied in the spring at about the time the grass is starting to grow actively. Some control of broadleaf weeds will also be obtained from these chemicals, but treatment with 2,4-D and/or related herbicides will probably be required to give satisfactory weed control.

TURFGRASS ESTABLISHMENT

Glyphosate (ROUNDUP) at 1.5 to 2 lb (active) per acre in 20 to 30 gal of water applied postemergence when vegetation is actively growing and quack grass has at least four leaves. Allow 5 or more days after applications before tillage. For maximum quack grass control a repeat treatment may be necessary before grass establishment. If necessary wait until quack grass has reached the 3- to 4-leaf stage.

For other perennial weeds follow label instructions for proper rate and stage of growth.

TABLE 5. A SUMMARY OF HERBICIDES USED TO CONTROL LAWN WEEDS

Weed	Growth* Habit	Herbicide**	Remarks
Avens, yellow	p	mixtures	hard to kill
Bedstraw	p	mixtures	repeat treatment
Bellflower	p		hard to kill
Bindweed	p	2,4-D	repeat treatment
Blueweed	b	2,4-D, mixtures	repeat treatment
Buttercup, Creeping	p	MCPA, mixtures	repeat treatment
Chickweed, Common	a	mixtures	readily controlled
Chickweed, Mouse-eared	p	mixtures	readily controlled
Cinquefoil, Silvery	p	2,4-D, mixtures	repeat treatment
Daisy, English	p	mixtures	repeat treatment
Daisy, Ox-eye	p	2,4-D, mixtures	treat when young
Dandelion	p	2,4-D	readily controlled
Dandelion, Fall (see Hawkbit, Fall)	p	2,4-D	readily controlled
Dock, Curled	p	2,4-D, mixtures	treat when young
Fleabane, Annual (Daisy fleabane)	wa	2,4-D, mixtures	treat when young
Goutweed	p	—	hard to kill
Grass, Crab	a	See Page 75	preemergence
Grass, Quack	p	–	try to crowd out
Ground-ivy (Creeping Charlie)	p	mixtures	treat when young
Hawkbit, Fall (Fall Dandelion)	p	2,4-D	readily controlled
Hawkweed	p	2,4-D, mixtures	repeat treatment
Heal-all	p	mixtures	treat when young
Knotweed, Prostrate	a	dicamba	treat when young
Mallow, Round-leaved	p	mixtures	hard to kill
Medick, Black	wa	mixtures	treat in June
Moss	p	iron sulfate	improve turf
Oxalis (Wood Sorrel)	p	mixtures	hard to kill
Pansy, wild	p	mixtures	hard to kill
Plantain, Common	p	2,4-D	readily controlled
Plantain, Narrow-leaved (Ribgrass)	p	2,4-D	readily controlled
Sandwort, Thyme-leaved	a	mixtures	readily controlled
Sheep Sorrel	p	mixtures	hard to kill
Shepherd's-purse	wa	2,4-D	treat when young
Speedwell, Corn	a	mixtures	hard to kill
Speedwell, Purslane	a	mixtures	treat when young
Speedwell, Thyme-leaved	p	mixtures	treat when young
Stonecrop	p	mixtures	treat when young
Toadstools	p	copper sulfate	improve turf
Yarrow (Milfoil)	p	mixtures	hard to kill

a = annual, b = biennial, p = perennial, wa = winter annual.

*** "Mixtures" refers to commercially available combinations of 2,4-D with mecoprop, dichlorprop, fenoprop and/or dicamba. If using 2,4-D alone use a rate of 1 oz of active chemical in 4 gal water on 2,500 sq ft of lawn. If using one of the mixtures, carefully follow the manufacturers' directions.*

WOODY NURSERY STOCK

WEEDS	TREATMENT
Seedling annuals and germinating seeds	CHLORAMBEN (ORNAMENTAL WEEDER, WEEDONE GARDEN WEEDER), 4 lb (active) per acre. Preemergence to weeds. CHLORPROPHAM (CIPC), (20% active) granular, 30 to 50 lb (product) per acre. CHLORTHAL DIMETHYL (DACTHAL), 8 to 15 lb (product) per acre in 30 gal water. Preemergence to annual grass seedlings and some broadleaf weeds. DIPHENAMID (ENIDE), 4 to 8 lb (active) per acre. EPTC (EPTAM), (2.3% active) granular, 1 lb (product) per 200 sq ft. SIMAZINE (PRINCEP), 2 to 3 lb (active) per acre. Wettable powder or granular. Apply before weeds emerge. Follow manufacturer's directions. (Check label for species which can be treated.) TRIFLURALIN (TREFLAN), ½ to 1 lb (active) per acre. Preplant incorporated immediately after spraying.
Emerged annual and perennial weeds	GLYPHOSATE (Roundup), ¾ to 1 lb (active) for the control of annual weeds, 1½ to 2¼ lb (active) for the control of quack grass, 2¼ to 3¼ lb (active) for the control of other perennial weeds in 20 to 40 gal water per acre as a directed treatment in established nursery plantings.
Quack grass	DICHLOBENIL (CASORON), 4 to 6 lb (active) per acre. Granular. Check label for list of species on which it is safe. PRONAMIDE (KERB), 1½ lb (active) or 3 lb (product) per acre -- or 1 oz (product) per 1000 sq ft. Apply in fall to control quack grass and common chickweed.
Grass and annual broadleaf weeds	PARAQUAT (GRAMOXONE), 1 lb per acre in 50 to 100 gal water per acre. For spot treatments 1 oz per gal water. Directed spray.

WARNING – Certain kinds of woody nursery stock may be injured by the above herbicides. Check the manufacturer's recommendations. CHLORPROPHAM (CIPC) should not be used on tree fruit nursery stock. Rates given apply to area actually covered if row only is treated.

SIMAZINE should only be used on established plantings. Nursery stock can be injured by a residue in the soil if these herbicides are used where stock is removed and replaced with another planting. This herbicide cannot be used about ornamental shrubs, if the area is to be underplanted to ground cover or bedding plants.

TRIFLURALIN must be incorporated immediately after application. This treatment does not control ragweed, black nightshade, or mustards, and lady's-thumb may escape the treatment. Annual grass control is usually excellent. EPTC (EPTAM) should be applied to a dry soil surface and incorporated immediately with a double disk or on small areas with a heavy rake.

CHLORAMBEN, CHLORPROPHAM and CHLORTHAL DIMETHYL are useful for controlling seedling annual weeds. All are more effective when applied before the weed seeds germinate and when the soil is moist and warm.

DIPHENAMID should be applied in late fall directly over established nursery stock. Apply to clean cultivated land as established weeds are not controlled. This treatment should control many winter annual and annual weeds during the following spring.

DICHLOBENIL is applied as a granular material. It i effective if applied in fall for control of quack grass.

GLYPHOSATE should be applied to actively growin weeds. For the control of quack grass, GLYPHOSATE should be applied when the quack grass has at least 4 new leaves on each shoot. Canada thistle should be in the early bud stage, field bindweed is at full flower and milkweed i at the bud stage of growth. DO NOT ALLOW SPRAY OR SPRAY DRIFT TO CONTACT LEAVES OR GREE BARK OF TREES OR SHRUBS. Use recommended preemergence herbicides to provide residual control of weed seedlings.

PARAQUAT is used as a chemical mower and as such can be used several times a year. Direct spray to wet leaves of weeds but avoid wetting the leaves or green bark of th crop plants. Better results are usually obtained if applications are made on dull cloudy days, or during the evening.

PRONAMIDE must be applied in the fall when the soi temperature is low but above freezing. Soil moisture should be high for best results or 1/2 to 1 inch of water should be applied by overhead sprinkler irrigation after treatment.

ERADICATING PERSISTENT PERENNIALS OR SHRUBS

WEEDS	TREATMENT
Shrubs or herbaceous perennials	**AMMATE X, 1¼ lb (product) per 100 sq ft. Apply either dry or at 1 lb per gal water.**

The treatment with AMMATE is useful in handling persistent perennial weeds, perennials that have become too aggressive, or shrubs such as lilacs, in garden areas. The chemical at the above rate will render the soil barren for about one season. However, it will break down in time, and the soil fertility will not be impaired.

Damage may occur to desirable trees or other plants with roots that enter the treated area, or to plants located in lower portions of the garden onto which the chemical has been washed. Due precautions should be taken.

SEEDBEDS, POTTING SOIL, etc.

WEEDS	TREATMENT
Seeds of most weeds	**DAZOMET (MYLONE), 1¹/₃ lb per 100 sq ft.** **DAZOMET (BASAMID), 11 to 15 oz product per 100 sq ft for potting soil. For liner beds 250 lb per acre product or 10 oz per 100 sq ft.** **METAM (VAPAM), 1 qt (product) per 100 sq ft.** **METHYL BROMIDE, (Dowfume MC2) under gas-proof cover, 1 lb per 100 sq ft.** **VORLEX, 6 to 30 oz of product per 100 sq ft.**

METAM is applied as a drench to a soil that should be wet to a depth of at least 3 inches. Do not plant for 10 to 14 days, or longer if the weather is cool.

The beds on which DAZOMET is to be used should be prepared approximately a week before treatment. The soil should be moist and free of clods. Apply DAZOMET evenly over the soil with a fertilizer spreader and irrigate with sufficient water to move the herbicide into the soil. DAZOMET (BASAMID) should be incorporated into the soil to a depth of 4 to 6 inches. Incorporation with a rotary cultivator fitted with L-shaped tines is recommended. Fall applications may be made as long as the soil is at 5°C or more to the 2-inch depth. Keep the soil moist and delay planting for 14 to 21 days, or longer if the weather is cool.

For potting soil DAZOMET (BASAMID) should be spread over a 10-inch layer of soil at the rate given above. The layers and heap should be watered immediately after treatment. Thorough incorporation and covering the heap with a plastic sheet may be advantageous.

DAZOMET, METAM, METHYL BROMIDE, and VORLEX are effective in the destruction of weed seeds, the control of nematodes, and the control of a number of soil-borne plant diseases.

METHYL BROMIDE is a poisonous gas which is applied under a gas-proof (usually plastic) cover. Its use is subject to the Pesticides Act. It may be used by the producer on his own seedbeds but he must obtain a permit from the Ontario Ministry of the Environment each time it is used. The manufacturer's instructions should be followed closely and the seedbed or greenhouse aired thoroughly after the treatment. If there is any question, the safety precautions in the Pesticides Act should be studied or inquiry made of the local office of the Ontario Ministry of Agriculture and Food or the Ontario Ministry of the Environment.

VORLEX is a liquid which is injected into the prepared seedbed by means of special applicators. The soil should be sealed immediately by rolling or packing. The rate used will depend on the depth of soil to be treated, the soil type, and the pests to be controlled.

SPECIAL METHODS OF WEED CONTROL

SITE PREPARATION

WEEDS	TREATMENT
Quack grass, bindweed, and many emerged broadleaf weeds and grass	**GLYPHOSATE (ROUNDUP), 2 to 3¾ lb (active) in 20 to 30 gal water per acre.**

GLYPHOSATE can be applied on actively growing weeds in spring or fall before transplanting grapes, apples, or ornamental nursery stock. Cultivation should be delayed 5 or more days before the first cultivation. Planting ca take place without further delay.

STALE SEEDBED

WEEDS	TREATMENT
See note below	**PARAQUAT (GRAMOXONE) or DIQUAT (REGLONE), ½ to 1 lb per acre (active) in 25 or more gal water per acre, or 1 fl oz (product) in 2 gal water per 1000 sq ft. (See note below).** **PARAQUAT plus DIQUAT MIXTURE (WEEDRITE or WEED-BAN), 4 tablespoons in 1 to 2 gal water per 200 sq ft.**

These herbicides are registered for use on beans, beets, carrots, cole crops, cucumbers, onions, peas, potatoes, soybeans, sweet corn, and turnips. This practice requires early preparation of the seedbed and delay of seeding for several weeks. Seeding should be done with equipment which provides minimum disturbance of the soil. After the weeds have emerged, but before the crop has emerged, one of the above-named contact herbicides is applied.

The emerged weeds will be killed but the treatment will not leave a harmful residue in the soil. The method is mos successful when conditions are best for weed seed germination and a complete weed cover develops. The soil shoul be disturbed as little as possible after treatment or a nev crop of weeds will appear.

PARAQUAT will kill many of the common broadle weeds and all of the common annual grasses. DIQUAT wil kill more kinds of broadleaf weeds but is not as successfu in killing grass.

INTER-ROW WEEDING

WEEDS	TREATMENT
Emerged weeds	**PARAQUAT (GRAMOXONE), ½ to 1 lb (active) per acre. Postemergence in 25 to 100 gal water.** **PARAQUAT plus DIQUAT MIXTURE (WEEDRITE or WEED-BAN), 4 tablespoons in 1 to 2 gal water per 200 sq ft.**

Inter-row weeding can be used as a rescue operation where other methods of weed control cannot be used or have failed in vegetable, field, and established crops. The herbicide should be directed between rows from shortly after weed emergence until weeds are 12 inches high using special low pressure (1 to 2 psi) application equipment (dribble bar, Vibrajet, etc. with shields) designed to prevent spray contact with the green foliage or other living parts of the crop.

PARAQUAT can be used effectively on emerged vegetation using this special equipment. Only emerged vegetation which is contacted with spray is killed. There is no residu in the soil to kill later germinating weeds. Maximum inter row coverage can be obtained when the crop is at an earl stage of growth. PARAQUAT should be applied whe weeds are at an early stage of growth (from shortly afte emergence until 12 inches high). Use 1 lb per acre PARAQUAT after weeds are 2 inches high. Use 25 to 30 g water with the Vibrajet and 50 to 100 gal per acre with th dribble bar.

ROADSIDES AND NON-CROP AREAS

The control of vegetation in waste places, driveways, parking areas, ponds, ditches, along roadsides and railroads, and under power lines is of interest to many groups.

Fencerows and Farm Areas

The farmer recognizes that weeds growing in fencerows, around buildings, and on roadsides are sources of potential weed infestation to other parts of his farm. In addition, brush and weeds around his fields harbor insects, diseases, and other pests that may be detrimental to his farming operations, or shrubs like wild cherry may be possible sources of livestock poisoning. He may also wish to reclaim land on which willows or brush have encroached. Moreover, he has a pride in his farm and will not tolerate unkempt areas.

Chemicals that may be used to control such vegetation are listed in the sections "Pasture Weeds", page 34, "Short-term General Vegetation Control", page 84, "Perennial Weed Control", page 86 and "Brush Control", page 88 and "Coniferous Brush Control", page 89. Care must be taken to avoid damage to crops in adjacent fields. Avoid soil sterilants if the chemical is likely to wash onto areas where crops are grown.

Roadsides, Rights-of-way and Waste Places

The road superintendent is interested in controlling weeds and brush to reduce the cost of his winter snow-removal program. Low vegetation will also give the road-user a clear view of other vehicles, animals, children, and other hazards. The engineer must prevent brush encroachment onto the roadway proper, keep the drainage ditches open, and even think of the fire hazard of dry vegetation in late summer. A grass cover, he finds, prevents soil erosion much better than weeds. With a minimum of care it also gives a well-kept appearance to the property under his control.

In some situations chemical growth retardants can be used to reduce grass growth (page 83).

Both railway and power-supply authorities are concerned with maintaining safe and accessible rights-of-way by controlling growth of weeds and brush.

In certain areas (beneath guard rails, in storage yards, and under the fences at road intersections), it may be advantageous to completely kill all vegetation for a longer period of time. Chemicals and suggestions for their use in this way are presented in the section on "Long-term Total Vegetation Control", page 85.

In roadside and right-of-way spraying, for weed control (page 81), or brush control (page 88), precautions should always be taken to minimize herbicide drift (see page 82). For further information on roadside spraying see Ontario Ministry of Agriculture and Food Publication 550, *Roadsides — Clear and Clean.*

General Vegetation Control

All citizens are interested in the farmer's efforts towards more efficient production and in the engineer's plans for increased highway safety and more attractive roadsides. They also appreciate any program that will control ragweed, poison-ivy, and other plant pests that cause so much human misery each year. Methods of controlling weeds in and around such places as driveways, storage yards, parking lots and, more recently, in farm ponds and other water areas, are of interest to diverse individuals throughout Ontario.

All of these groups are interested in the control of vegetation as safely and as economically as possible. The use of vegetation-controlling chemicals, commonly known as herbicides, is a big step in this direction.

ROADSIDE WEED CONTROL

The main objectives of a weed control program for roadsides are: (1) to control tall growing weeds so that mowing costs can be minimized, (2) to control weeds that may infest adjacent land by wind dispersal of seed, (3) to maintain an attractive grass cover that will minimize erosion problems, (4) to prevent buildup of excessive vegetation that can become a fire hazard in late summer or complicate snow removal in winter. Most broadleaf weeds are susceptible to early summer applications of 2,4-D and related herbicide (see Table 7, page 95). However, many weeds are not effectively controlled by 2,4-D mixtures and these resistant weeds can become an increasing problem unless other herbicides are used. The use of spot treatments with non-selective chemicals that may temporarily injure the grass may be justified in some cases to control isolated but dense patches of difficult weeds before they spread and become a major problem over a large area.

GENERAL BROADLEAF WEED CONTROL

WEEDS	TREATMENT
Annual broadleaf weeds in newly constructed areas and biennial or perennial broad leaves, susceptible to 2,4-D	2,4-D, 16 oz (acid) as the AMINE or LOW-VOLATILE ESTER in 20 to 30 gal water per acre applied in early summer. See Table 7 (pages 95 and 96) for weed susceptibilities to 2,4-D, and 2,4-D mixtures.
Most biennial and herbaceous perennial weeds	2,4-D/2,4,5-T (1/1) AMINE or LOW-VOLATILE ESTER mixtures at 32 to 48 oz (acid) in 20 to 50 gal water per acre. Apply in early summer. See Table 7 (pages 95 and 96) for listing of weed species tolerant to 2,4-D alone.
	2,4-D/DICHLORPROP (1/1) mixture as LOW-VOLATILE ESTER at 32 oz to 48 oz (acid) in 20 to 50 gal per acre. Apply in early summer. DICAMBA + 2,4-D, ½ to 1 plus 1 to 2 lb (active) per acre in 10 to 20 gal water.
Wild carrot	2,4-D/2,4,5-T (1/1) 32 to 48 oz (acid) as AMINE or LOW-VOLATILE ESTER applied in early summer to control second year plants prior to seeding or in early fall to control first year plants. Some types of wild carrot may be more tolerant to this treatment than others and may require repeated treatment.

SPOT TREATMENTS FOR DIFFICULT WEEDS

WEEDS	TREATMENT
Canada thistle, perennial sow-thistle	DICAMBA/2,4-D, at 16 oz total acid per acre as the AMINE in late spring just prior to flowering.
	AMITROLE or AMITROLE T, 4 lb (active) in 50 to 100 gal water, applied when the thistles are in the head stage of growth. Use spot treatments only since grasses are susceptible to this chemical and may be controlled for up to one season.
Leafy and cypress spurge	TBA (Trichlorobenzoic acid), 10 to 20 lb acid per acre or 4 to 8 oz acid per 1000 sq ft in sufficient spray volume to thoroughly wet all foliage. Apply as a spot treatment only, grass cover may be removed for one season.
Field bindweed	DICAMBA, 8 oz per acre applied in mid-June or when flowering.
	2,4-D, 16 oz (acid) per acre applied in mid-June when flowering and repeated in early September.
Milkweed	AMITROLE or AMITROLE T, 4 lb (active) in 50 gal water. Spray to wet in early summer before flowering. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to 1 season.
Field bindweed, milkweed and Canada thistle	GLYPHOSATE (ROUND-UP), 2 to 3 lb per acre in 20 to 30 gal water. Apply when field bindweed has reached full flower, Canada thistle has at least started to flower and milkweed has at least reached the bud stage. Use spot treatments only, since grasses are susceptible to this chemical and may be controlled for up to one season.

While it is important to control weeds on roadsides, it is absolutely essential to take precautions to avoid damage to no target vegetation adjacent to the roadside or right of way (see section on Reduction of Herbicidal Drift below).

REDUCTION OF HERBICIDAL DRIFT

In the application of herbicides, especially of the hormone type (2,4-D, 2,4,5-T, mecoprop, dichlorprop, dicamba, etc), sensitive crops (grapes, tomatoes, turnips, tobacco, beans, carrots, beets, fruit trees, ornamental plants and many others) beyond the area being sprayed can be damaged by vapor drift or spray drift. To reduce the danger of herbicidal drift:

1. Use only amine formulations when it is necessary to apply hormone type herbicides near sensitive non-target plants.
2. Use the lowest pressure possible to apply the herbicide. This may mean the use of a dribble bar, vibrajet nozzle, Directa-spra nozzle, flood jet or more conventional nozzle tips.
3. Manufacturers' recommendations regarding nozzle spacing and height should be carefully followed. It may be necessary to mount nozzles on skids to keep them a constant distance from the surface to be sprayed.
4. For roadside spraying, various spray additives, i BIVERT PH, Norbak-60, or Nalco-Trol are availabl which may reduce spray drift by increasing the viscosit or density of the spray. These materials should be use following manufacturers' directions, and observin normal precautions (vehicle speed, wind velocity, proximity to sensitive crops, etc).

WARNING These methods and materials can reduce but do not eliminate herbicidal drift. In areas near sensitive crops, all normal precautions must be taken. It should be emphasized that extremely low, even invisible, amounts of spray drift can be very damaging to sensitive crops. In some cases, spraying during the growing season should not be considered.

ROADSIDE GRASS RETARDATION

There has been considerable interest in growth-modifying chemicals which will control the quantity of growth rather than be toxic when applied to plants.

Retardation of the growth of grasses and some broadleaf plants on roadsides can be achieved by spraying with MALEIC HYDRAZIDE (SLO-GRO) at 4 to 6 lb per acre in 40 gal water per acre. The turf should be 3 or more years old and should be growing vigorously at time of treatment.

MAINTAIN CF125 at 2 to 3 lb per acre is also recommended for grass retardation on roadsides and ditch banks.

Treatments should be applied in spring when the grass has started to grow actively. In southern Ontario the best time is early to mid-May, depending on season variations.

If the grass height is uneven, then the area should be mowed before spraying to improve its appearance.

Fresh mowings and other debris should be removed before spraying so that the spray is not prevented from reaching the growing grass. No mowing should be done for at least one week after treatment.

The growth of certain weeds is not controlled by MALEIC HYDRAZIDE. The use of an amine salt of 2,4-D at the rate of 2 lb active ingredient per acre is therefore recommended. The 2,4-D can be mixed with MALEIC HYDRAZIDE and the 2 chemicals applied at the same time.

MAINTAIN CF125 will control several broadleaf weed species including dandelion, black medick and chickweed.

Experience has shown that occasionally there is a slight yellowing of the grass after application of either MALEIC HYDRAZIDE or MAINTAIN CF125. Often the grass takes on a dark blue-green color.

WEED CONTROL IN DRY DITCHES

When ditches on roadsides or in other locations contain standing or moving water, herbicides should not be applied to emergent weeds without consulting the Ontario Ministry of the Environment regarding the need for a permit (see WEEDS IN AQUATIC ENVIRONMENT, page 92). However, such permits aren't normally necessary for the application of herbicides to control weeds adjacent to ditches or weeds in ditches when no water is present.

WEEDS	TREATMENT
Cattails	AMITROLE (AMITROL, AMIZOL), 8 to 10 lb (active) per acre in 400 gal water, ⅕ to ¼ lb active in 10 gal water per 1000 sq ft. Apply when cattails are actively growing. DALAPON, 10 to 20 lb (product) per acre, mixed in 100 gal water, ¼ to ½ lb (product) in 4 gal water per 1000 sq ft. Apply after seed heads have formed. GLYPHOSATE (ROUND UP) at 2¼ to 3¾ lb in 75 to 100 gal water per acre or 1 gal (product) in 100 gal water applied to wet. Apply during mid- to late-flower stage (mid-July to late-August) when cattails are actively growing. PARAQUAT (GRAMOXONE), 1 to 2 lb (active) in 75 to 100 gal water per acre, ½ to 1 gal (product) per acre. Apply when seed heads are forming, usually late July or August.
Bulrushes	2,4-D ESTER, 2 lb (active) in 75 to 100 gal water per acre.
Other weeds	See ROADSIDE WEED CONTROL, page 81 and Table 7, page 95, for the most effective treatments for the species present.

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SHORT-TERM TOTAL VEGETATION CONTROL

(Foliage Treatment Chemical Mowing)

Chemicals offer an alternative to mowing in areas where top-kill of short vegetation is desired. They are often convenient and economical, especially close to fences, around buildings or where the terrain is rough. The chemicals listed below are first applied when the growth is about 6 inches high. Spray to runoff. Tall vegetation is more difficult to kill and can become an unsightly fire hazard when it dies.

TREATMENT

AMITROLE (AMITROL, AMIZOL), 4 to 6 lb (active) per acre in 20 to 40 gal water (3 to 5 oz product in 2 gal water per 1000 sq ft).

AMITROLE T (AMITROL-T, CYTROL), 3.6 lb (active) per acre (6 fl oz product) in 4 gal water per 1000 sq ft.

DIQUAT (REGLONE) or PARAQUAT (GRAMOXONE), 1 to 2 lb (active) per acre in 100 gal water, 2 to 4 fl oz (product) in 4 gal water per 1000 sq ft. (See note below.)

SODIUM CHLORATE MIXTURES or POLYBOR CHLORATE, 1½ lb (product) per gal water or AMMATE X, ⅔ lb (product) per gal. Wet all foliage.

GLYPHOSATE (ROUNDUP), 1½ to 2 lb (active) in 20 to 40 gal water per acre.

All treatments recommended above except AMITROLE and ROUNDUP are with **contact chemicals** -- chemicals that "burn" any leaves they touch. Subsequent treatments, 2 or 3 during the season, will be required to keep the cover short.

The AMMATE X and the SODIUM CHLORATE MIXTURES and POLYBOR CHLORATE are supplied in water so as to wet all foliage. These chemicals are corrosive to metal and special care with sprayer maintenance is important. The use of SODIUM CHLORATE MIXTURES helps to reduce the fire hazard associated with the use of the pure chemical. CHLORATES are, however, poisonous to livestock and proper precautions should be taken when using them.

DIQUAT and PARAQUAT should be used at the higher rates and with a higher volume of water for dense weed growth. For chemical mowing along roadsides and other areas where a scorch is desired, ½ lb PARAQUAT will be adequate. DIQUAT and PARAQUAT may be added to tank mixes of soil sterilants such as ATRAZINE or DIURON where immediate top-kill and long-term sterilization are desired.

AMITROLE, AMITROLE T, or ROUNDUP must be applied to actively growing foliage to be effective. These treatments are slower acting than the others mentioned in this group. With AMITROLE, treated plants stop growing and turn white before dying. Regrowth is from freshly germinating plants or underground parts of perennial weeds. All foliage should be thoroughly wet for best results. The addition of BROMACIL at 1.6 lb (active) per acre will increase the length of control obtained with the AMITROLE treatments and only one treatment may be required per season.

Do not use soil sterilants such as ATRAZINE, DIURON, and BROMACIL around useful trees.

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LONG-TERM TOTAL VEGETATION CONTROL

(Bare Areas – Soil Sterilization)

It may be desirable to maintain certain areas completely free of vegetation. Usually two problems are involved. First, the existing vegetation must be destroyed – including the destruction of underground stems and roots of perennials. Second, the bare area thus produced must be maintained either by long-term soil sterilization or by foliage treatment of weed seedlings.

Some soil sterilants will kill existing vegetation. Others, while excellent for maintaining the bare area, may be used more economically if combined with another chemical to kill existing growth. If a mixed population of weeds is present, combinations of chemicals that will kill the different types may be used advantageously.

TREATMENT

AMMATE X, POLYBOR CHLORATE, SODIUM CHLORATE MIXTURES, as recommended in "Short-term Total Vegetation Control" section, page 84. Repeat applications are necessary for bare areas.

AMIZINE, 20 lb (product) per acre. Apply in 100 gal water per acre, when weeds are growing actively.

BROMACIL (HYVAR X, HYVAR XL), 5 to 10 lb (active) per acre or 2½ to 5 oz (product) in 4 gal water per 1000 sq ft.

BROMACIL + DIURON (KROVAR), 10 to 13 lb (active) per acre.

DIURON (KARMEX), 15 to 20 lb (active) per acre or 10 oz (product) per 1000 sq ft. Do not use on driveways.

MIXTURES OF BORATES AND CHLORATES WITH OTHER HERBICIDES. Several of these mixtures are available. Follow manufacturer's directions.

PROMETONE, 20 lb (active) per acre.

KARBUTYLATE (TANDEX), 5 to 10 lb (active) per acre or 2½ to 5 oz (product) in 4 gal water per 1,000 sq ft.

SIMAZINE or ATRAZINE, 10 to 20 lb (active) per acre or 5 to 10 oz product in 4 gal water per 1000 sq ft.

SIMAZINE + ATRAZINE (ERAMOX), 10 to 20 lb (active) per acre or 5 to 10 oz product in 4 gal water per 1000 sq ft.

ERBOTAN, 5 to 10 lb (active) per acre for one or two seasons control, respectively.

TEBUTHIURON (SPIKE), 5 or 10 lb (active) per acre for 2 or 3 seasons control, respectively.

CAUTION – The above chemicals may sometimes be used to treat areas that are close to gardens, desirable trees, etc. Since these chemicals will kill any plant that they contact, special care and forethought must be used in their application. If the area (for example, a driveway) is higher than the nearby flower beds, the chemical may wash onto them with the first rain. If trees or shrubs are feeding under the treated area, the chemical may leach to their roots and cause injury.

Uniform coverage with all chemicals is essential. Touch-up operations should be expected, as a single treatment will seldom give complete eradication.

It is usually found that two applications of the lower recommended rate, ie 5 to 10 lb per acre depending on the chemical used, spaced 6 to 12 months apart, gives better results than one single application of the higher recommended rate.

The length of weed control obtained with soil sterilants will depend on several factors which include the rainfall, soil type and amount applied. Control is usually maintained longer in heavier soil types, while in sandy soils and gravel areas the length of effective control is much less.

Certain weed species survive and/or readily reestablish from seed on treated sites. These include plaintain on DIURON-treated sites; mullein on BROMACIL-treated sites, crabgrass on ATRAZINE-treated sites, field horsetail on ERBOTAN or SPIKE treated sites and dandelion on KARBUTYLATE treated sites.

The regrowth of these species can be prevented by treatment with herbicides which kill these plants, ie 2,4-D for dandelions and plantains.

Care should be exercised when selecting a chemical to use on driveways because washing of the chemical onto nearby lawns and gardens may occur. In situations where this may occur it is advisable to use one of the chemicals listed under "Short-term General Vegetation Control", page 84 or "Driveway and Patios", page 73.

PERENNIAL WEED CONTROL (NON-CROP LAND)

Perennial weeds are more difficult to control than annual weeds because regrowth occurs rapidly from underground parts after the top growth is removed by chemical or mechanical means. In non-crop land they pose a special problem because cultivation cannot be used for their control. Chemicals must kill the root system as well as the aboveground parts to give effective perennial weed control.

WEEDS	TREATMENT
All perennials, nonselective control	DIURON (KARMEX), 15 to 20 lb (active) in 100 gal water per acre or 10 oz (product) in 4 gal water per 1000 sq ft.
	SIMAZINE or ATRAZINE, 10 to 20 lb (active) per acre or 5 to 10 oz (product) in 4 gal water per 1000 sq ft. Apply as a coarse spray, agitating mixture.
	SODIUM CHLORATE MIXTURES 2 lb or AMMATE X, 1½ lb (product) per 100 sq ft. Use dry or at about 4 lb product per gal water.
	BROMACIL (HYVAR X, HYVAR XL), 5 to 10 lb (active) per acre or 2½ to 5 oz (product) in 4 gal water per 1000 sq ft. Follow manufacturer's directions regarding agitation.
	AMIZINE, 20 lb (product) per acre. Apply in 100 gal water per acre, when weeds are growing actively.
	BROMACIL + DIURON (KROVAR), 10 to 13 lb (active) per acre.
2,4-D-susceptible weeds	2,4-D, 16 to 24 oz acid as the amine or low-volatile ester in 20 to 30 gal water per acre. See Table 7 (pages 95 and 96) for list of weed susceptibilities to 2,4-D and related chemicals.
Evergreens and brush (less than 5 ft)	See sections on Brush Control and Evergreen and Conifer Control, pages 88 to 89, for susceptibility of woody species to 2,4-D and related compounds.
Canada thistle, perennial sow-thistle	DICAMBA, 2,4-D mixtures 8 to 16 oz total acid per acre.
	AMITROLE or AMITROLE T, 4 lb (active) in 50 to 100 gal water. Spot treatments when thistles are in the head stage of growth.
Leafy and cypress spurge, field bindweed	BORATE COMPOUNDS, 1½ to 2 lb product per 100 sq ft.
	MIXTURES OF BORATES AND CHLORATES WITH OTHER HERBICIDES. Several of these mixtures are available. Follow manufacturer's directions.
	TBA (Trichlorobenzoic acid), 10 to 20 lb acid per acre or 4 to 8 oz acid per 1000 sq ft.
Field bindweed, milkweed and Canada thistle	GLYPHOSATE (ROUND-UP), 2 to 3 lb per acre in 20 to 30 gal water. Apply when field bindweed has reached full flower, Canada thistle has at least reached the bud stage.
Milkweed	AMITROLE or AMITROLE T, 4 lb (active) in 50 to 100 gal water per acre as a spot treatment before flowering.
Goldenrod	2,4-D/2,4,5-T mixture, 1 to 2 lb acid per 100 gal water. Apply in June and wet all foliage.
Quack grass and other creeping-rooted grasses	AMITROLE (AMITROL, AMIZOL), 4 to 6 lb (active) per acre (2 to 3 lb for control) or ½ oz per sq yd.
	AMITROL T, 1½ gal per acre. Wait at least 10 days before plowing or disking.
	GLYPHOSATE (ROUNDUP), 1½ to 2 lb (active) in 20 to 30 gal water per acre. Apply when quack grass is actively growing and has 3 to 4 new leaves on each shoot. Wait at least 5 days before mowing or working the area.
	DALAPON, 10 to 15 lb (product) per acre or 4 oz per 1000 sq ft (7 to 10 lb for control). Wait at least three days before plowing or disking.
	PRONAMIDE (KERB), 1 to 1½ lb (active) per acre in 30 to 40 gal water. Apply in fall, late September to early November, before soil freezes.
	ATRAZINE (See recommendations under Field Corn, page 28).
Perennial weeds in pastures	See pages 34 and 35.

WARNING – Unless otherwise recommended, the above treatments should not be used in crop situations. Their use should also be avoided if the chemical is likely to wash or leach into areas occupied by the roots of desirable trees or other plants. Precautions should also be followed to avoid spray drift onto non-target vegetation.

The use of SODIUM CHLORATE MIXTURES, ATRAZINE, SIMAZINE, BROMACIL, DIURON, BORATE COMPOUNDS or AMMATE X nonselectively, as described above, is generally limited by cost to the handling of small patches of perennial weeds. The chemical either leaches down to the weed root system, or makes the surface soil toxic for a period of time, varying from a few months to several years depending on the chemical, rate of application, and soil type. Generally, crops cannot be grown successfully until the effect of the chemical has disappeared. Corn, however, can be grown safely when high rates of SIMAZINE and ATRAZINE are applied.

Some perennial weeds such as field bindweed, horsetail, goldenrod, milkweed and bracken fern are difficult to eradicate at the lower rates of DIURON, SIMAZINE, ATRAZINE, and BROMACIL. Mixtures of these chemicals with SODIUM CHLORATE or BORATES are usually more effective on these weeds.

Use the SODIUM CHLORATE MIXTURES to reduce the fire hazard associated with the pure chemical. All SODIUM CHLORATES may be poisonous to livestock. Follow directions on the container carefully when using this chemical. Special precautions are outlined in discussion of this chemical on page 21.

DALAPON, AMITROLE or AMITROLE T must be applied to actively growing quack grass foliage to be effective – DALAPON will remain toxic to most crops for a period of 4 to 5 weeks after application; longer if cold or dry weather occurs. With AMITROLE and AMITROLE T, most field crops can be planted safely 2 to 3 weeks after application of the chemical. Follow the manufacturer's directions carefully if the area is to be reseeded. Both the DALAPON and AMITROLE treatments are of value in spottreating patches of quack grass in a field that is not entirely infested. KERB is effective for the control of quack grass and other perennial grasses; however, most broad-leaved weeds are not controlled.

While the tops of many perennial weeds may be controlled by doses of 2,4-D that may be selectively used in resistant crops, heavier doses, as described above, must be used if eradication is to be attempted. Several applications upon successive states of regrowth will probably be necessary. Generally, treatments with 2,4-D during rapid development of the weed, at about the early bud to flowering stages of growth, are most effective. Spray should be applied to thoroughly wet all foliage.

Heavier doses of 2,4-D on patches of weeds may be applied during normal selective spraying operations merely by slowing down the sprayer speed in the infested areas. Local crop damage should be expected where this is done.

The more persistent weeds such as leafy spurge and field bindweed are difficult to eradicate with 2,4-D, and a long-range control program using this chemical is usually followed. TBA gives good control of such deep-rooted perennials. Its action is similar to 2,4-D but it persists much longer in the soil.

2,4-D is ineffective against quack grass and other grassy perennials.

POISON-IVY CONTROL

Several chemicals have been shown to be effective for the control of poison-ivy. However, some growth may occur after treatment with any of these chemicals and retreatments will be necessary to achieve eradication. The chemical treatment for poison-ivy must take into account the location in which the weed is growing. If desirable shrubs or trees are present, the soil sterilants should be avoided, and the other materials used with caution.

TREATMENT

AMITROLE (AMITROL, AMIZOL), 3 lb (active) per acre in 100 to 200 gal water or 2 oz (product) in 3 gal water. Thoroughly wet all foliage.

AMITROLE T (AMITROL-T, CYTROL), 3.6 lb (active) per acre in 100 gal water or 1½ fl oz (product) per gal water. Thoroughly wet all foliage, apply when plants are actively growing.

AMMATE X, ¾ to 1 lb (product) per gal water. Thoroughly wet all foliage.

FENOPROP (SILVEX), 2½ lb (acid) per acre, or ½ oz (acid) in 3 gal water. Thoroughly wet all foliage.

SODIUM CHLORATE MIXTURES or POLYBOR CHLORATE, 1½ lb to 2 lb (product) per gal water per 100 sq ft. Spray foliage and ground area.

2,4-D, 2,4-D/2,4,5-T, or 2,4-D/DICHLORPROP LOW-VOLATILE ESTER formulations, 2 lb (acid) per acre, or 2½ oz (acid) in 10 gal water. Thoroughly wet all foliage.

BORATE COMPOUNDS, 4 to 6 lb (product)* per 100 sq ft.

2,4-D, MECOPROP, DICAMBA (KILLEX) mixtures, at 16 oz + 8 oz + 1.5 oz per acre in 10 gal spray.

2,4-D + DICAMBA, at 16 oz + 8 oz per acre in 10 gal spray.

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A 2- or 3-gallon sprayer is the most convenient method of applying herbicides to patches of poison-ivy. Thorough coverage of the leaves with the spray is essential for maximum effect. After spraying, the area should be left alone until the plants die, then the dead stems should be gathered up and buried. Even at this stage care should be taken as poisoning may be brought about by handling the de plant.

All treatments are most effective when the poison-ivy in full leaf and growing actively, from about June 15 July 31.

BRUSH CONTROL

There are several techniques that may be used for the chemical control of deciduous woody species: stem foliage sprays, basal bark sprays, frilling or spot treatments. The choice of technique will depend on such factors as brush type, accessibility, availability of equipment, proximity susceptible crops or ornamental vegetation, and the size the control program.

Stem Foliage Treatment

Stem foliage treatment of brush should be limited to smaller growth (less than 10 ft in height). Treatments should be applied to thoroughly wet the stems and foliage to the point of runoff. This technique is most effective just after full leaf development in late spring or early summer.

The choice of chemicals for controlling stands of dec duous brush should be based on the susceptibilities of t predominant species (see Table 6, page 91), or whether th brush to be controlled is near homes, recreational areas, et

SPECIES	TREATMENT
See table 6	**2,4-D AMINE or LOW-VOLATILE ESTER, 48 to 64 oz (acid) per 100 gal water. One application is sufficient for susceptible species.**
	2,4,5-T AMINE or LOW-VOLATILE ESTER, 48 to 64 oz (acid) per 100 gal water.
	2,4-D/2,4,5-T (1/1) AMINE or LOW-VOLATILE ESTER, mixtures at 48 to 64 oz (acid) per 100 gal water.
	2,4-D/DICHLORPROP (1/1) LOW-VOLATILE ESTER, 80 to 96 oz (acid) per 100 gal water.
	AMMONIUM SULFAMATE or SODIUM CHLORATE MIXTURES, concentrations of ¾ or 1 lb per gal water. Use spray volumes between 100 and 200 gal per acre depending on density of brush, or spray until runoff. Either of these treatments is useful where spray and vapor drift might harm crops.
Ash, hickory, oaks	**DICAMBA (DYCLEER) at 40 oz + 2,4-D AMINE or LOW-VOLATILE ESTER, per 100 gal water.**
	DICAMBA (DYCLEER) at 32 oz + 2,4-D/DICHLORPROP (1/1), 64 oz (acid) per 100 gal water (TANK MIX).
Oaks, maples	**FENOPROP (SILVEX), 3 to 4 lb per 100 gal water. This treatment is more effective than 2,4-D or 2,4,5-T on oak or maple.**
Oak, maple, alder, hickory and ash	**KRENITE, 5 to 7 lb per 100 gal water. Thorough coverage is essential. The addition of 0.25 to 0.5 per cent surfactant (WK, TWEEN 20, or TRITON X-100) may be required for difficult species like poplar or in stands mixed with conifers.**

Basal-Bark Treatment

The BASAL-BARK treatment is useful on a wide range of trees and brush with a trunk diameter up to about 6 inches. The chemical is applied so as to thoroughly cover the basal 12 inches of the trunk and any exposed roots. For oak, hickory, basswood, or ash, treatments are most effective from February to June. Most other species may be treated at any season of the year.

Light, simple equipment, coupled with the possibility of winter operations, when labor is cheaper and access to swampy areas possible, give this treatment an important spot in a brush control program.

SPECIES	TREATMENT
Most species	2,4-D/2,4,5-T LOW-VOLATILE ESTER MIXTURE, 2 lb acid per 10 gal fuel oil.
Hawthorn	2,4-D LOW-VOLATILE ESTER, 3 lb acid per 10 gal fuel oil.

Stump Treatment after Cutting

In many cases it is more desirable to remove existing brush by hand than to kill it by spraying and leave the dead material standing. The stump treatment is particularly useful in preventing the vigorous regrowth that is the characteristic response of many deciduous species after the cutting. Moreover, killing the stump is the first step towards encouraging it to rot.

All of the treatments must be applied to freshly exposed wood. They may be applied at any season of the year, preferably right after the tree or brush is cut. If, however, an old stump is to be killed, it should be split with a wedge, or have holes drilled into it, so that fresh wood should be exposed to the chemical. Regrowth from an old stump should be treated as well as the stump proper.

If spray is used, all surfaces of the stump should be treated. Various dye (Dupont Rodamine Red) materials may be added to the herbicide to facilitate keeping track of sprayed stumps.

WEEDS	TREATMENT
Most species	AMMATE X, 25 lb (product) in 10 gal water or 1 oz (dry) per inch of stump diameter. Spray, paint, or dry applications.
	SODIUM CHLORATE MIXTURES, 1½ oz (product) per inch of stump diameter, dry application.
	2,4-D LOW-VOLATILE ESTER or 2,4-D + 2,4,5-T mixture, 2 lb acid in 10 gal fuel oil. Spray or paint.

EVERGREEN or CONIFER CONTROL

Foliage Treatment

All of the treatments are applied so as to thoroughly wet all foliage. Use low pressure and apply from 50 to 150 gal solution per acre, depending on the amount of foliage.

The TCA treatments of evergreens, applied during the growing season, will control balsam, spruce, and pine. Thorough coverage is particularly important, and the addition of a wetting agent will increase effectiveness.

TBA (TRICHLOROBENZOIC ACID) is also effective on evergreens. It may be applied alone, or with AMMATE X, or 2,4-D/2,4-T mixtures.

SPECIES	TREATMENT
Spruce, balsam, pine	TCA, 10 to 15 lb acid per
	TBA (TRICHLOROBENZOIC ACID), 3 lb acid per 100 gal water
	AMMATE X, in oil-water emulsion, 60 lb product per 100 gal oil-water emulsion. Follow manufacturer's directions.
	PARAQUAT (GRAMOXONE), 1 lb per 100 gal water. Apply in spring or early summer. Thorough coverage is needed.
Mixed stands (conifers and deciduous brush)	The above treatments can be combined with the 2,4-D, 2,4,5-T, DICHLORPROP treatments that are recommended for the species of deciduous brush present (see Table 6, page 91).
	DICAMBA AMINE (DYCLEER), 40 oz + 2,4-D AMINE OR LOW-VOLATILE ESTER at 80 oz per 100 gal water.
	DICAMBA AMINE (DYCLEER), 32 oz + 2,4-D/DICHLORPROP (1/1) LOW-VOLATILE ESTER at 64 oz per 100 gal water applied in spring or early summer. Thorough coverage is needed.

GENERAL TREATMENTS FOR WOODY SPECIES

Soil Treatment

Single or scattered trees or shrubs may be controlled efficiently with dry applications of BORATES, CHLORATES, or AMMATE X. Apply the chemical in a band at the base of the plant, following the manufacturer's di tions.

Sucker Control After Pruning

Many trees sprout prolifically after they have been pruned. The application of fortified tree-wound dressings to the surface of the cuts can reduce the number of new sprouts from many tree species. These paints improve natural inhibition achieved through the use of proper trimm techniques. They do not substitute for poor trimming p tice. All pruning should be done to strong laterals. Se pruning should be avoided.

SPECIES	TREATMENT
Willow, poplar, maple, oak, elm, basswood, apple	**Surface tree-wound dressing containing 1% ALPHA NAPHTHALENEACETIC ACID, ETHYL ESTER (TRE-HOLD).**
	Aerosol can containing a light asphalt and 1% ALPHA NAPHTHALENEACETIC ACID, ETHYL ESTER (TRE-HOLD).

Best results will be obtained if the materials are applied to the cuts between April 15 and July 15. Treatment of all cuts is important, as each is a potential location for sprouting from both dormant and adventitious buds. Cover the entire cut and about ¾ inch of the surrounding bark e cially below the cut. Heavy tree-wound dressing will versely affect rate of callus formation of some species.

METRIC EQUIVALENTS

1 lb per acre = 1.12 kg/ha (kilogram per hectare)
1 kg/ha = 0.89 lb per acre

1 gal per acre = 11.2 ℓ/ha (litre per hectare)
1 ℓ/h = 0.7 pt per acre

SEE PAGE 97
FOR OTHER METRIC EQUIVALENTS

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TABLE 6. CLASSIFICATION OF WOODY PLANTS IN RELATION TO SUSCEPTIBILITY TO FOLIAGE SPRAYS OF 2,4-D, 2,4,5-T, 2,4-D/2,4,5-T, 2,4-D/DICHLORPROP MIXTURES, AND AMMONIUM SULFAMATE.

Common name	2,4-D	2,4,5-T	2,4-D 2,4,5-T (1:1)	2,4-D Dichlorprop (1:1)	Ammonium sulfamate
alder	S-I	S-I	S-I	S	
arborvitae	R	R	R		S-I
ash	R	I-R	R	S-I	
barberry, common	I	S	S	S	
basswood	R	I-R	I-R	S	
beech	R	I	I		S-I
birch	S	S	S	S	S
blackberry	R	S	S		I-S
blueberry	S	S	S	S	I
buckthorn	I-R	I-R	I-R		I
cedar	R	R	R	I	S-I
cherry, black, red	S-I	S	S	S	S
cherry, choke	S-I	S	S	S	S
cranberry	S	S	S		
creeper, Virginia	S	S	S		R
currants, wild	R	S	S		I
dogwood	S-I	S-I	S-I	S	S-I
elderberry	S	S-I	S-I		S-I
elm	I	I	I-S	S	S-I
fir, balsam	R	R	R	S	S-I
grape, wild	S	S	S		
hardhack, spiraea	I	I	I		I
hawthorn	I-R	I	I	S	I
hemlock	R	R	R		S-I
hickory, black, shagbark	R	I-R	I-R	S-I	S-I
honeysuckle	S-I	S-I	S-I	S	S
ironwood	R	I	I		I
juniper	R	R	R	I-S	I-R
lilac	I-R	S-I	S-I		I
locust, black	I	I	I		I
locust, honey	S-I	S-I	S-I		I
maple, Manitoba	S-I	S	S		S-I
red	R	I-R	I-R	I	S-I
silver	S-I	S	S		S
sugar	R	S-I	S-I	S	S-I
oak, red	I	I-S	I-S	I-S	S
white	I	I-S	I-S	S	S
bur				R-I	
pine	R	R	R	S-I	S
plum, wild	I	S	S	S	
poison ivy	I	I	I	S	S
poplar, aspen	S	S	S	S	I
prickly ash	R	I	I		
raspberry, wild	R	S	S	S	I-S
redbud			S		
rhododendron	R	I	I		R
rose, wild	R	S	S	I	
sassafras	S-I	S	S		I-S
sheep-laurel	I	I	I		
spruce	R	R	R	I-R	
sumac, poison	S	S	S		
sweet fern	I	S-I	S-I		S-I
viburnum	R	I-R	I-R		I
walnut	S-I	S	S		S
willow	S	S	S	S	S

S	**Susceptible.** Adequate control obtained with one application.
I	**Intermediate.** Retreatment is usually needed for adequate control.
R	**Resistant.** Two or more applications may not be adequate.

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TABLE 7. CLASSIFICATION OF WEEDS ACCORDING TO RESPONSE TO VARIOUS FOLIAGE SPRAYS

	2,4-D	2,4,5-T	MCPA	2,4-DB or MCPB	Fenoprop (Silvex)	Mecoprop	Dicamba
aster (P)	I	I			I		
bedstraw (P)	R	I	R	R	S-I	S-I	
bellflower (P)	R	R			R		
bindweed, field (P)	I	I	I	I	I	I	I
blueweed (B)	S-I	S-I			I	I	I
bracken fern (P)	R	R	R	R	R	R	I
buckwheat, wild (A)	I	I	I	I-R	I	I	S
burdock (B)	S	S	S	I	S		S
buttercup (P)	I	I	S-I	I**(I-R)	I	I	
campion, bladder (P)	R	R	R	R	I-R		
carrot, wild (B)	S-R	S	S-R	R	S	I-R	
catchfly, night-flowering (A)	R	R	R	R	R	R	
catnip (P)	S-I	S					
chickweed, common (A)	I	I	I	R	S	S	S
chickweed, mouse-eared (P)	I-R	I	I-R	R	S	S	S
chicory (P)	S	S-I	S-I	S-I*(R)	S-I	I-R	
cinquefoil, rough (WA)	I				I		
cinquefoil, (P), sulfur (upright c.)	I	I			I		
cocklebur (A)	S	S	S	S	S	S	S
cockle, purple (A)	I-R	R	R	R	R		I
cockle, white (P)	R	R		I-R			I
daisy, ox-eye (P)	I	I	I	R	I		
dandelion (P)	S	S	S	I*(R)	S	I	
dock (P)	I	I	I	I	I-R	I	
evening-primrose (B)	S	S-I			S		
false flax (WA)	S	S	S	S	S	S	
fleabane, annual (WA) (daisy f.)	I	S-I	I	S-I	S		
fleabane, Canada (A)	S-I	S-I			S-I		
goat's beard (B)	I	S-I			S-I		
goldenrod (P)	I	S	R	I	I		
goosefoot (A)	S	S	S	S	I	S	
goutweed (P)	R	R	R	R	R	R	
grasses (A and P)	R	R	R	R	R	R	
ground-ivy (P) (creeping charlie)	I-R	I-R	I-R		I	I	S
groundsel (A)	I		I				
hawkweed (P)	I-R	I-R	I-R				
heal-all (P)	I-R	I-R	I-R	I-R	S	S	
hemp-nettle (A)	R	I	S-I	I-R**(R)		R	
horse-nettle (P)	R	I-R			I-R		I
horsetail (P)	I-R	I-R		I-R		I-R	I
knapweeds (P)	R	I					I
knotweed (A)	I	I		I*(I-R)	S-I	S-I	S
Lady's-thumb (A)	I	I	R	I-R*(R)	I	I	S
lamb's-quarters (A)	S	S	S	S	S	S	S
lettuce, prickly (A)	S	S	S	S	S	S	
mallow, round-leaved (P)	I-R	I-R	I-R	I-R	I-R	I-R	
mayweed (A)	I-R	I-R		R	I		S
medick, black (WA)	I	S-I	I	I	S	S	I
milkweed (P)	R	I	R	R	I	I-R	
motherwort (P)	S-I	S-I					
mullein (B)	I-R	I					
mustards (A)	S	S	S	I	S	S	
nightshade (P)	I-R	I			I	R	
parsnip, wild (B)	S	S					
pepper-grass, common (WA)	S	S	S	I			
pepper-grass, field (WA)	S	S-I	S	I	I		
pigweeds (A)	S	S	I	S-I	S	S	S
pineappleweed (A)	S			R		R	
plantains (P)	S	S	S	S-I	S	S-I	I
purslane (A)	I	S	I	S-I	S-I	S-I	

TABLE 7. CLASSIFICATION OF WEEDS ACCORDING TO RESPONSE TO VARIOUS FOLIAGE SPRAYS (cont'd)

	2,4-D	2,4,5-T	MCPA	2,4-DB or MCPB	Fenoprop (Silvex)	Mecoprop	Dicamba
ragweeds (A)	S	S	S	S	S	S	
ragwort	R						I
ribgrass (P) (see plantains)							
rocket, yellow (B)	S	S	I	I*(I-R)			
shepherd's purse (WA)	S	S	S	I	S-I		
smartweed, green (A)	I		I	I		R	S
sorrel, sheep (P)	I	I-R	R		I-R		
sow-thistle, annual (A)	S	S	I	S		I	
sow-thistle, perennial (P)	I	I	R	S-I*(I-R)	I		S-I
speedwells (A or P)	I-R	I	I-R		S-I	S-I	
spurge, cypress (P)	I-R	I	I-R	I-R	I		I
spurge, leafy (P)	I-R	I	I-R	I-R	I	R	I
spurry, corn (A)	R	R	I	R	I	I	S
St. John's wort (P)	R	R	R	R	R	R	
stinkweed (pennycress) (WA)	S	S	S	S-I	S	S	S
stonecrop, mossy (P)	I	I	I		S-I	S-I	
teasel (B)	I	I			I		
thistle, bull (B)	S	S	S	S	S	S	
thistle, Canada (P)	I	I	I	I		I	S-I
thistle, nodding (B)	I			I			
thistle, Russian (A)	S-I	S-I		I-R	S-I	R	S-I
toadflax (P)	R	R	R	R	R	R	
velvetleaf (A)	S-I	S-I	I	S-I*(I-R)			
vetch (P)	I-R	I-R	I-R	R	I-R	I-R	I
vetches, wild (A)	S	S	S		S		
violet, field (field pansy) (A)	R					R	
water-hemlock (P)	S-I	S					
wood-sorrel (P)	I-R						
yarrow (P)	R	I-R			I	I	

*_2,4-DB more effective_ [_susceptibility to MCPB given in brackets_]

**_MCPB more effective_ [_susceptibility to 2,4-DB given in brackets_]

KEY: Plant Classification

(A) annual

(WA) winter annual

(B) biennial

(P) perennial

Response to Foliage Sprays

S **susceptible** i.e. killed by 1 application of 2,4-D, MCPA, Fenoprop (Silvex) or Mecoprop (16 oz/acre or less); or by 1 application of Dicamba (6 oz/acre or less).

I **intermediate** i.e. killed less rapidly but controlled, either by higher rates or by repeated applications.

R **resistant** i.e. only slightly damaged by chemical treatment. Control of these weeds is not practical with herbicides listed in table.

S-I between susceptible and intermediate.

I-R between intermediate and resistant.

WEED CONTROL GLOSSARY

~~(Also see Notes on Chemicals from pages 13 to 22)~~

ACID (2,4-D, glyphosate) – the active part of the product being used -- usually indicated in ounces per gallon on the label.

ACTIVE INGREDIENT – the chemical compound in a product that is responsible for the herbicidal effects.

ADJUVANT – an ingredient added to the spray mixture to improve the action of the herbicide. Similar to a surfactant.

AMINE – type of formulation of a chemical. (See page 16.)

BAND TREATMENT – a herbicide applied as a narrow strip over the crop row, usually followed by inter row cultivation.

COMPATIBLE – compounds or formulations that can be mixed and applied together without undesirably altering their separate effects.

CONTACT CHEMICALS – chemicals which kill only the parts of the plant on which they are sprayed.

DIRECTED TREATMENT – a treatment directed onto the weeds or soil in such manner as to avoid contact with the crop.

DORMANT – a resting stage similar to the condition of a plant during the winter.

EMERGENCE – the time at which the seedling first appears above the ground.

ESCAPE – a plant in a treated area that has missed or survived the treatment.

ESTER – type of formulation of a chemical. (See page 16.)

FORMULATION -- means the same as PRODUCT – an active ingredient processed with other materials to make it usable; or, the type of herbicide commercially available, such as amine, low-volatile ester or sodium salt of 2,4-D.

HERBICIDE – a chemical which is used to kill or inhibit weeds.

HORMONE-TYPE HERBICIDE -- includes 2,4-D, 2,4-DB, 2,4,5-T, mecoprop, fenoprop, MCPA, MCPB, dichlorprop, dicamba, TBA, fenac, picloram.

LOW-VOLATILE ESTER – a formulation of chemical which, after application, is less likely to damage nearby plants by vapor activity than regular esters.

NONSELECTIVE HERBICIDE – a chemical used in such a manner that all vegetation – both weed and crop -- is damaged.

PERENNIAL – a plant that lives for more than 2 years.

PRODUCT – the contents of a herbicide container as marketed. It contains the active ingredient and other solvents, surfactants or carriers that are referred to as inert ingredients.

PROGRAM -- application of one or more herbicides at two different stages of crop and/or weed growth. The second herbicide application is used to provide control of the weeds either escaping the original herbicide treatment or which are problems at different periods in the growth of the crop.

RESISTANT -- a crop not damaged by a herbicide if applied as recommended, or a weed not controlled by any practical rate of herbicide.

SELECTIVE HERBICIDE – a chemical used in such a manner that it will kill weeds in a growing crop without damaging the crop.

SODIUM SALT – type of formulation of a chemical.

SOIL STERILANT – a nonselective chemical that acts through the soil to prevent the growth of plants.

SURFACTANT – an ingredient added to the herbicide formulation to improve the spreading, sticking or wetting properties of the spray, sometimes referred to as a dispersing agent.

SUSCEPTIBLE – a crop that may be damaged – or a weed that may be controlled readily by a recommended rate of herbicide.

TANK MIX -- two chemicals that are purchased separately and mixed in the sprayer tank -- as opposed to a mixture formulated by the manufacturer (Kil-Mor, Amizine).

TRANSLOCATED HERBICIDE – a chemical (herbicide) that moves within the plant.

TRIAL USE ONLY – this term is used to denote that the treatment has not been tested enough for a general recommendation, but is sufficiently safe and promising to be tried on a limited area and is registered for that use.

WEIGHTS AND MEASURES

1 imperial gallon = 4 quarts = 8 pints = 160 fluid ounces
= approximately 1.2 U.S. gallons

1 U.S. gallon = .8345 or approximately 5/6 imperial gallon

1 imperial gallon of water weighs 10 pounds

1 imperial quart = 2 pints = 40 fluid ounces

1 imperial pint = 20 fluid ounces = 2½ cups

1 measuring cup = 8 fluid ounces

3 teaspoons = 1 tablespoon = ½ fluid ounce

1 ton = 2,000 pounds

1 pound = 16 ounces

1 ppm = one part per million by weight
= 1 pound in 100,000 gallons of water

100 ppm = 1 pound in 1,000 gallons of water
= 1.6 ounces in 100 gallons of water

1:1000 by weight: means 1 part of material by weight in 1,000 parts of another by weight.

eg., 1 ounce of copper sulfate in 1,000 ounces of water (=25 quarts = 6¼ gallons of water).

eg., 1 gram of copper sulfate in 1 litre of water.

1 ounce per 1,000 square feet is approximately 3 pounds per acre.

1 pint = 20 fluid ounces of spray mixture per 1,000 square feet = the 5 gallons per acre rate.

To convert Imperial gallons to U.S. gallons, multiply by 1.2
To convert U.S. gallons to Imperial gallons, multiply by 0.8345 (or.83)

1 mile = 5,280 feet = 1,760 yards - 320 rods
1 rod = 16.5 feet = 5.5 yards
1 yard = 3 feet = 36 inches
1 foot = 12 inches
1 acre = 43,560 square feet = 4,840 square yards
= 160 square rods
1 square yard = 9 square feet
1 mile an hour = 88 feet a minute
1 square foot = 144 square inches
1 rod x 1 mile = 2 acres.

METRIC EQUIVALENTS

LENGTH

inch = 2.54 cm
foot = 0.3048 m
yard = 0.914 m
mile = 1.609 km

millimetre = 0.039 in.
centimeter = 0.394 in.
decimetre = 3.937 in.
metre = 3.28 ft
kilometre = 0.621 mile

AREA

square inch = 6.452 cm^2
square foot = 0.093 m^2
square yard = 0.836 m^2
square mile = 2.59 km^2
acre = 0.405 ha

Metrification of pesticide labels will take place between January 1, 1977 and January 1, 1979.

AREA

cm^2 = 0.155 square inches
m^2 = 1.196 square yards
km^2 = 0.386 square miles
ha = 2.471 acres

VOLUME (dry)

cubic inch = 16.387 cm^3
cubic foot = 0.028 m^3
cubic yard = 0.765 m^3
bushel = 36.368 litres
board foot = 0.0024 m^3

cm^3 = 0.061 cubic inches
m^3 = 31.338 cubic feet
hectolitre = 2.8 bushels
m^3 = 1.308 cubic yards

VOLUME (liquid)

fluid ounce (Imp) = 28.412 ml
pint = 0.568 litre
gallon (Imp) = 4.546 litres

litre = 35.2 fluid ounces (Imp)
hectolitre = 26.418 gal (U.S.)
= 21.997 gal (Imp)

WEIGHT

ounce = 28.349 g
pound = 453.592 g
hundredweight (Imp) 45.359 kg
ton = 0.907 tonne

gram = 0.035 oz.
kilogram = 2.205 lb
tonne = 1.102 short ton

PROPORTION

1 gal/acre = 11.231 litres/ha
1 lb/acre = 1.120 kg/ha
1 lb/sq in = 6,895 kilo Pascals (KPa)

1 litre/ha = 14.24 fluid oz/acre
1 kg/ha = 14.5 oz. avdp/acre
1 kg/ha = 0.89 lbs/acre
1 metric tonne/ha = 0.45 ton/acre
1 ton/acre = 2.24 metric tonne/ha

POISON CONTROL CENTRES IN ONTARIO

BARRIE

Royal Victoria Hospital
Emergency Department
(705) 728-9802

BELLEVILLE

Belleville General Hospital
Emergency Department
(613) 968-5511

BRANTFORD

Brantford General Hospital
Dr. C. H. Pickett
(519) 752-7871

St. Joseph's Hospital
Dr. D. Swan
(519) 753-8641

BURLINGTON

Joseph Brant Memorial Hospital
Dr. D. Raes
(416) 624-1080

CHATHAM

St. Joseph's Hospital
Emergency Department
(519) 352-2500

GUELPH

St. Joseph's Hospital
Dr. J. J. Brown
(519) 824-2620

HAILEYBURY

Temiskaming Hospital
Director
(705) 672-3314

KAPUSKASING

Sensenbrenner Hospital
Emergency Department
(705) 335-6041

KINGSTON

Kingston General Hospital
Dr. C. J. Padfield
(613) 547-2001

KIRKLAND LAKE

Kirkland and District Hospital
Director
(705) 567-5251

KITCHENER

Kitchener-Waterloo Hospital
Dr. Swan
(519) 742-3611

St. Mary's General Hospital
Dr. W. H. Friday
(519) 744-3311

LONDON

Victoria Hospital
Emergency Department
(519) 432-5241

OTTAWA

Children's Hospital
Emergency Department
(613) 521-4040

Ottawa General Hospital
Emergency Department
(613) 231-2121

PICTON

Prince Edward County Memorial Hospital
Emergency Department
(613) 476-2181

ST. CATHARINES

St. Catharines General Hospital
Dr. W. G. Sollich
Emergency Department
(416) 684-7271

SARNIA

Sarnia General Hospital
Dr. C. Sorensen
Emergency Department
(519) 344-3661

SAULT STE. MARIE

Plummer Memorial Public Hospital
Emergency Department
(705) 254-5161

SIMCOE

Norfolk General Hospital
Dr. K. R. McGavin
(519) 426-0750

SUDBURY

Sudbury General Hosptal
Dr. E. S. Lapchinski
(705) 674-3181

THUNDER BAY

McKellar General Hospital
Dr. G. F. Rogan
(807) 623-5561

Port Arthur General Hospital
Dr. Arnot R. Hawkins
(807) 344-6621

TORONTO

Toronto East General and
Orthopedic Hospital
Dr. Donald Price
(416) 461-8272

Hospital for Sick Children
Dr. Raymond Ng
(416) 597-1500

WINDSOR

Hotel Dieu de St. Joseph
mergency Department
(519) 252-3631

[1] ALLOGUARD 80W

[7] HERBICIDE NET WEIGHT 5LB/2.62 KG.

[3] WETTABLE POWDER FOR TOTAL WEED CONTROL
ON NON-CROP LAND (AGRICULTURAL AND INDUSTRIAL USES)

[2] COMMERCIAL

CAUTION POISON

READ THE LABEL BEFORE USING

[6] GUARANTEE:

ALLOZINE	80%
INERT INGREDIENT	20%

[5] REGISTRATION #25100

[8] GUARD CHEMICAL OF CANADA LIMITED
901 HAMILTON STREET
TORONTO, ONTARIO

KEY POINTS

1) Trade Name of Product: Alloguard 80W
2) Use Category: Herbicide - Commercial
3) Formulation: Wettable Powder
4) Symbol
5) PCP Act, Registration No. #25100
6) Guarantee: Allozine - 80% (Common name)
7) Net Contents: 5lb = 2.62kg
8) Manufacturers or Formulations Name and Address
9) Directions for Use
10) Cautions
11) First Aid and Toxicological Information.

NOTICE TO USER: This control product is to be used only in accordance with the directions on this label. It is an offence under the PEST CONTROL PRODUCTS ACT to use a control product under unsafe conditions.

NOTICE TO BUYER: Seller's guarantee shall be limited to the terms set out on the label and subject thereto, the buyer assumes the risk to persons or property arising from the use or handling of this product and accepts the product on that condition.

DIRECTIONS FOR USE

Non-Crop Land (Agriculture and Industrial Use) Total Weed Control.

Apply 4-8 oz in 0.5 - 5 gal per 1000 square feet. For annual weeds and perennial seedlings, use the lower rate. For light growth of shallow-rooted perennials, use the intermediate rate. For well-established perennials, use the higher rate. In Eastern Canada, a fall application of the intermediate rate will adequately control all weeds. Apply with an efficient sprayer to obtain an even cover of the land to be treated. Use the higher volumes of water where old vegetation is dense or obstructions frequent. Rainfall is required to move the chemical into the root zone.

Farm - Total Vegetation Control.

Apply 0.75 - 1.0 oz in 1 - 2 gal per 100 square feet. SPOT TREATMENT: For quickest results, treat before or during emergence of weeds, or shortly thereafter. Apply uniformly in dry form or as a spray. This treatment will control most annual and perennial weeds. Excessively dry soil conditions and absence of rainfall may result in poor weed control.

CAUTION.

Keep out of reach of children. Harmful if swallowed. Avoid breathing dust or spray mist. Avoid contact with skin, eyes and clothing. No residue tolerance established for fish. Do not contaminate any body of water. Do not contaminate foods or feeds. Very little spray drift hazard to standing crops and ornamentals becuase it is effective through roots only. Crops and flowers will not be affected unless their roots spread into the treated area. Under conditions of heavy rainfall, sufficient to cause erosion, soil containing allozine may wash to lower areas of land, and injury to existing or subsequent crops, other than corn, may result. After using, wash sprayer thoroughly with clean water. Do not reuse empty container.

FIRST AID.

If swallowed, induce vomiting by giving warm water containing a tablespoon of salt. If inhaled, get medical attention.

TOXICOLOGICAL INFORMATION.

Treat symptomatically.

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